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Mining Laboratory of the Missouri School of Mines

By C. R. Forbes*

SYNOPSIS—An outstanding feature of the laboratory work at the Missouri School of Mines is the practical work of drilling and blasting at the mine plant; other laboratory courses include work in compressed air, mine rescue and first aid. It is not aimed to make miners of the students but to give them a practical familiarity with mining tools that is not obtainable from books or mere observation.

One of the greatest difficulties in the teaching of mining is the lack of laboratory equipment to bring out the practical application of theories advanced in the class room. A number of the mining schools in this country are so fortunately situated in mining districts that this laboratory equipment is supplied by the mines themselves, although it is a question whether even laboratories of this kind are entirely sufficient, because the students in most cases can only be permitted occasional brief observations of mining operations and it is not possible to afford them the opportunity of actually carrying on any of the work themselves.

Student Drilling in the Missouri School of Mines' Tunnel, Rolla, Mo.

As there are no mines of consequence near the Missouri School of Mines at Rolla, a mining laboratory was deemed essential to supplement class-room work, and for that purpose the equipment herein described has been provided.

Four Laboratories Established

For class-room use there is the usual equipment of models showing mining methods, timbering details, headframe construction, explosive exhibits and a lantern with

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moving-picture attachment for showing mining operations.

It is always a problem in teaching to decide what to give to students and what to leave for them to gain from practical experience. Obviously, in a four-year course which includes the fundamentals and many "culture" subjects, it is not possible to devote sufficient time to cover thoroughly many branches that would be desirable. To meet the needs of some of the more important phases of mining work, four laboratories have been equipped as follows.

Mine-Rescue and First-Aid Laboratory

In accordance with the safety-first movement that has been making such rapid strides in the last few years, it has been deemed advisable to establish a mine-rescue and first-aid laboratory, where instruction is given in the use of breathing apparatus and in first aid to the injured. The equipment consists of three helmets, including a Dräger, Fleuss and Westfalia, a Pulmotor and all necessary first-aid supplies and charts. The time devoted to this laboratory does not exceed one afternoon a week for six weeks, but this is sufficient to familiarize the student with mine-rescue apparatus and to give him a fair knowledge of the principles of first aid.

Rock-Drilling Laboratory

On account of the importance of rock drilling in metal-mining operations, and also because it can readily be carried on in the laboratory, much stress is laid on this branch of the work, for which the following equipment is used: Piston drills: Ingersoll-Rand 2¼-in. auxiliary-arc-tappet drill; Ingersoll-Rand C-110 Butterfly; Sullivan 2¾-in. tappet; Sullivan 2¼-in. differential-valve, with steam and air front heads; Sullivan FF-12 with water attachment; Wood, 2¼-in. spool-valve. Hammer drills: Stopers—Waugh 16-V; Sullivan DA-21 with reverse feed; No. 7 Water Leyner; hand hammer drills—Ingersoll-Rand Jackhamer; Hardsocg; Cleveland.

In addition, there are three drills in section showing valve motion and construction, including a Sergeant tappet-valve machine, a Sullivan differential and a Murphy valveless hammer drill.

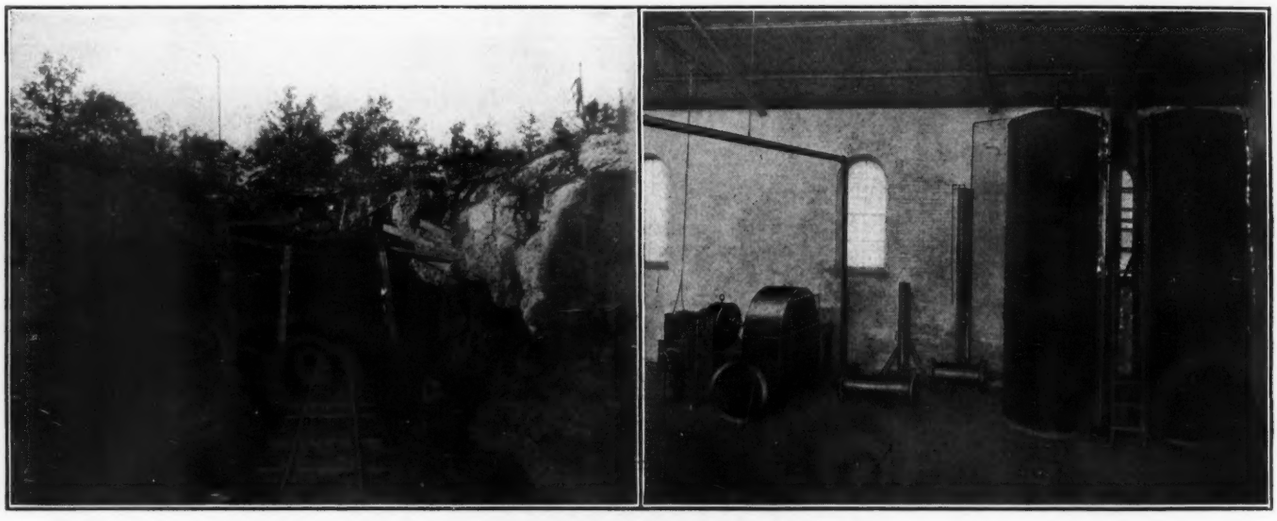
This equipment has been purchased from time to time as improvements have been made by the manufacturers, and although not complete, embraces most of the different types of air drills in use at present. Later it is planned to purchase electric and gasoline drills.

For the work of drilling, large blocks of red granite about 4x4x5 ft. are imported from southeast Missouri. Two drilling frames for supporting the machines on column and arm have been constructed—one under cover in a frame building and the other out of doors. In order to use the stopers, it is planned to place a rock over a concrete-lined pit of sufficient depth to provide head room for operating these machines.

For sharpening steel, besides the usual hand tools, there is a Leyner-Ingersoll 5-A sharpener with a complete assortment of dies and dollies for forming various-shaped bits including the cross, X, Z, bull, five-point, six-point, eight-point, high-center and single- and double-chisel bits, as well as parts for shanking Leyner, Jackhamer and piston steels.

The work done in this laboratory consists in sharpening steel both by hand and with the sharpener, and in drilling with the various machines. No attempt is made to drill a great number of holes, but the work consists in measuring cutting speeds with different bits and air pressures, noting variations in length and number of strokes under varying conditions and measuring air consumption. For this purpose a Sullivan air meter is used and an electrical device designed at the school is used for counting the number of blows of the drills.

The amount of time spent in the laboratory does not exceed 3 hr. a week or one laboratory period for one semester in the regular course, but much use is made of it in thesis work and interesting results have been obtained on the cutting quality of different-shaped bits.



Part of the Mining Laboratories of the Missouri School of Mines

Opencut and entrance to tunnel being driven by students

Displacement tanks and mine fan in compressed-air laboratory

Compressed-Air Laboratory

The use of compressed air is so important in mining operations that the school has deemed it advisable to equip this laboratory with apparatus that would be suitable not only for students' use, but also for purposes of research and investigation.

A Sullivan WB-2 straight-line air compressor of 290-

cu.ft. capacity supplies air for this laboratory as well as the rock-drilling laboratory, and a Laidlaw-Dunn-Gordon compressor used by the school in pumping from a deep well is placed in the same building and furnishes a different type for study.

The principal feature of this laboratory is the two measuring tanks, 15 ft. high and 5 ft. in diameter, shown in the accompanying photograph. With these large displacement tanks accurate measurements of air for the determination of orifice coefficients and various other experiments can be made. The apparatus was designed by Prof. E. G. Harris, head of the civil-engineering department. Another interesting installation in the compressed-air laboratory is the mine fan shown in the photograph. This is a 36-in. single-inlet Sirocco, directly connected to a 35-hp. variable-speed motor, and has a capacity of 20,000 cu.ft. against a 4-in. water gage. Two styles of runners with vanes at different angles are provided for experimental work. The fan is used in the regular laboratory work, where its efficiency is determined under varying conditions, and also for experimental work in air measurements, and the standardization of large orifices.

Mine Plant

The fourth mining laboratory is perhaps the most interesting in that it is more or less of an experiment and involves features that are radically different from similar laboratories at most other institutions.

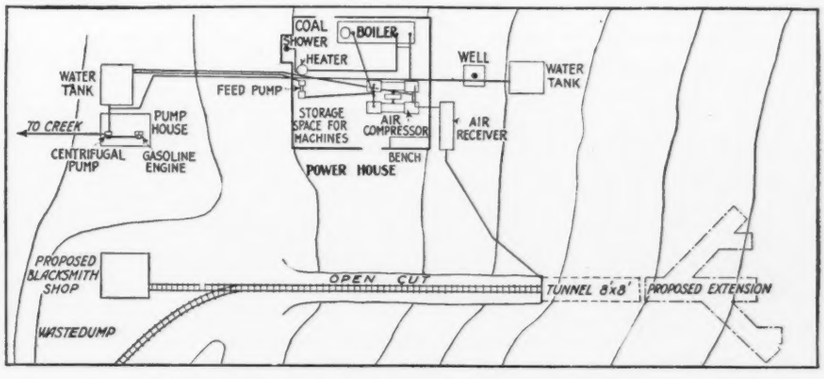
The plant is situated about 1½ miles from the school, which was the nearest point available where rock of a suitable nature could be found. A tunnel is being driven into the hillside, as shown in the engraving. The rock is a pitted dolomite, and although not particularly suited to the purpose, was the best available. At present the tunnel is in about 50 ft., practically all of this distance having been driven by students working one day a week for 12 weeks.

The power plant for running the machine drills used in the tunnel is shown in the accompanying plan and consists of a 50-hp. Erie fire-tube boiler and an Imperial type 10 Ingersoll-Rand air compressor of 100-cu.ft. capacity. Water for the boiler is pumped from a nearby stream with a centrifugal pump driven by a small gasoline engine.

In designing the power plant, an endeavor was made to introduce as great a variety of machinery as possible, as the operation of the power plant is considered one of the most valuable features of this laboratory work, being done entirely by the students. It is the intention to install a small engine and generator for furnishing lights and running an electric drill, in order to increase the drilling capacity of the plant and also to afford a greater variety of machinery.

As before stated, the lack of important mines in the immediate vicinity was the principal reason for installing this plant in the first place, but I am now of the opinion that such a plant would be desirable even though there were mines accessible. However, opinions may differ on this point; it is argued, and with good reason, that the student should not be required to spend a large part of his time at work partaking of the nature of manual labor or of learning a trade, and that he should be taught principles and theories only; also that he might obtain employment and receive pay for similar work and learn more at the same time. This is no doubt true, but the course is elective and is designed to give those students a chance at practical work who for some reason or other have neglected getting it for themselves. It is not the aim in this or in the rock-drilling laboratory to make miners and drill runners out of the men, and it is not claimed that this work should take the place of future practical experience, for the greatest benefit of that work is not gained in the laboratory, namely, the association with men, an insight into the point of view of the laboring man and a knowledge of what constitutes a day's work.

The total time spent in the mine-plant laboratory is about the same as in the rock-drilling laboratory, but instead of working the usual 3-hr. period, from 9 to 12 hr. are put in at a time, as a 3-hr. period is entirely too short for this kind of work.



Mine Plant of Missouri School of Mines

The work now being done by students consists in drilling, both by hand and with the different machines, blasting, timbering, laying track and operating the power plant. Most of the mucking is done by laborers in the interim between laboratory periods.

At present all efforts are being expended towards driving the main heading, but as soon as a suitable "back" has been obtained, drifts will be turned to the sides as shown in the sketch and then work can be carried on in several places at once. This will permit the assignment of individual places to parties of two or three men, who will be held responsible for their place and will be required to do a certain amount of work therein.

Eventually, it is planned to make the work largely experimental; different explosives will be used and their products of combustion analyzed; different methods of placing holes for blasting will be tried; time studies of drilling operations will be made and cost records of the work will be required. In addition to this the work of sharpening steel, timbering, mucking and track laying, together with the experience of running the power plant, will afford a greater variety of work than could ordinarily be obtained in a reasonable length of time in practice, and it is my firm belief that this work will be worth while if for no other reason than that it will do away to a large extent with that well known contempt of the average miner for the college man who so often is painfully ignorant of all practical details of mining.

Labor and Power Used in Cyanide Mills*

By Herbert A. Megraw

SYNOPSIS—Labor is one of the most variable of factors in ore treatment and depends upon plant location and chronological order, as well as upon the class of labor employed and its position in the scale of civilization. The actual figures vary from 6 to 23 tons handled per day per man employed. Power is also variable, but not so much as labor. It varies from 1 to 2.5 hp. for each ton of ore treated.

The amount of labor required to operate a cyanide mill varies in accordance with a number of different factors, and it is quite probable that there are no two mills, however similar they may be in a general way, that use the same details throughout. The kind of labor available is itself an important factor as may well be imagined, and it is quite clear that mills operating in Latin-America, those in the Orient and those in countries which may be presumed to be supplied with intelligent labor skilled in mining and metallurgical work, will have entirely different experiences with the labor factor.

The difference between the labor output in a community trained to mining and metallurgical usages and in one untrained in them is wider than might be imagined. In the mining camps of the western United States, for example, the ordinary workman is comparatively familiar with the general principles of mining and metallurgy and it is no great effort to him to pick up the particular characteristics of any process he may not already be familiar with. The consequence is that he provides an extremely high-grade labor factor in every way. On the other hand we may consider the labor formerly available in the mining districts of Ontario, such as Cobalt and Porcupine, and also that of the southeastern United States, Virginia, North Carolina, Georgia and Alabama. In all of these localities a class of labor exists that is highly intelligent, quite as much so as in the Western States, but which is by no means accustomed to the usages of mining and metallurgy. This class of labor has to be taught not only the details of the particular process involved, but the general principles of all mining and metallurgical processes, before it becomes efficient enough to compare in any way with the Western supply. The cyanide mills of Cobalt and Porcupine, in particular, have had this difficulty and have had to depend in large measure upon labor imported from the Western United States to form a ground work for the educating of the community. Labor of this class has not the same high factor as the labor in the West and cannot be expected to have until the community in general has grown so used to mining and metallurgical methods that it will have become a kind of second nature to them.

*This is the nineteenth of a second series of articles by Mr. Megraw. It deals with the comparative details of cyanide practice, discussing points of possible improvement. Preceding articles of this series appeared in the issues of Sept. 6, Oct. 4, Nov. 1, Nov. 15, Dec. 20, 1913; Jan. 31, Mar. 7, Mar. 21, Apr. 25, May 23, June 20, July 25, Aug. 29, Sept. 12, Oct. 17, Oct. 31, Dec. 5 and Dec. 27, 1914. The next and last article of this series will deal with "The Cost of Cyaniding," and will appear in the issue of Mar. 13, 1915.

Native Labor a Variable Factor

Handling native labor of different characters leads to an estimation of the comparative value of many different classes. In Mexico, for example, there exists in the mining country a large class of laborers thoroughly familiar with mining and metallurgy of a kind, but in neither case up to modern standards of efficiency. These people have to be educated into the methods used in modern plants, a procedure which is more or less difficult according to the locality in question. The physical quality of the Mexican has a great deal to do with his efficiency, and his methods of living, food supply, etc., tend to depreciate his value. Adding to this the fact that his intelligence is not up to the highest requirements, the total is a labor factor which is of distinctly lower efficiency than that of many other metal-mining communities.

Proceeding south in Latin America, the labor factor is found to vary astonishingly, without apparently vital dependence upon natural conditions. In general, it may be said that tropical labor is less efficient than that in temperate or colder zones, the reasons being that less energy is required to maintain life and comfort in tropical countries, and the natural tendency is toward depreciation. Therefore, it may be generally said that the nearer one approaches the equator, the less efficient is the labor. The altitude also has an appreciable effect, and it may be noted that the laborers of San Salvador, for instance, nearer the equator and in a hotter country, are more efficient than the natives of the lower-central Mexican highlands. Proceeding south, the labor is found to be less and less efficient, possibly reaching a minimum in the extremely high and barren country of Bolivia, where the supply available for the tin-mining industry is said to be extremely inefficient. South of this, as the more temperate zones are reached, the mining country not quite so high, and living conditions better, the labor improves rapidly.

In the Orient, in India, Chosen, and other such countries, the labor is found to be extremely inefficient. There is a theory obtaining among workers in various lands that the unit of labor accomplished costs about the same amount of money wherever it is purchased. For example, a rice-fed coolie, earning perhaps one-eighth of the daily wage of a high-grade, intelligent European or American workman, will perform only about one-eighth of the amount of labor. While this may be true in occupations which demand physical strength and endurance, such as heavy construction on railroads, docks, etc., it does not apply so much to metallurgical plants where the endurance requirement is not high. The work is comparatively easy in a physical sense, and the ordinary unintelligent native laborer can perform the routine operations after he has had suitable instructions. Of course, these people cannot equal the work accomplished by the skilled and civilized workmen, either in amount or quality, but aside from a greater or less amount of increase in actual numbers, the most important effect upon the labor situation is the requirement of more skilled superintendence. The civilized and intelligent laborer is to a great extent his

own superintendent, but the low-grade operator requires guiding.

Large Use of Low-Priced Labor

The greatest increase of labor found in native-operated plants is perhaps largely due to the tendency of managers and designers to make use of unskilled labor in place of modern and highly developed machinery. All over Mexico, and Latin America in general, and in the East, native labor may be found performing the tasks which are usually, in civilized countries, performed entirely by machines. Thus, in Mexico, one sees sands packed around by natives rather than handled on belt conveyors or other labor-saving machinery. There is no hesitation in emptying and cleaning out slime tanks with gangs of native laborers. In India, slimes are excavated from settling tanks and transported by natives in rush baskets, a procedure that could be avoided by the installation of proper machinery, but which is continued with the humanitarian idea of giving work to the largest possible number of people. In view of the fact that it is cheaper than can be accomplished by machinery in many cases, and allows the installation expense to be avoided, there is no economic objection to the procedure. However, when one comes to consider the labor factor in reference to the tonnage handled in a mill, it is quite clear that due consideration must be given to the location of a plant; that is, the country and class of labor at hand.

Influence of Plant Design

Aside from the large factor of labor character, there is the one of plant character. A plant of the old type will naturally make use of a much greater quantity of labor than one equipped in the most modern manner. But before considering this statement as usually true, it might be well to look about and find out just exactly what the facts are. Most operators will be surprised to find that, in reference to the number of tons treated per man employed, some of the older plants are doing much better than some of the most modern and uptodate. It is at this point that it must be realized that the scale upon which treatment is carried out also makes a vital difference in the labor factor. A plant handling ores on a magnificent scale will accomplish the handling of a much greater tonnage of material per man employed than a plant operating on a small scale where the same system is used. This is true even leaving out the factor of superintendence and fixed outside employees, which is, of course, much smaller in the large plant than in the small one.

The Effect of Topography

In addition to the chronological situation of the plant, another factor which has to do with the labor employed is the topographical condition under which it was designed and built. Generally speaking, plants built in flat country require more labor for their operation than do those which are built in a country which supplies convenient grades for gravity operations. It is, of course, not intended to imply that labor is employed in elevating pulp or solutions, but where much of this work is to be done, labor is certainly required to care for the machinery with which the work is performed. Pumps of all kinds require a good deal of attention and so do elevators of the belt, or air-lift types, tailings wheels, and all other kinds of machinery required to raise pulp, solution or dry ore.

In considering the examples which will be mentioned here showing the number of tons handled in the mills per man employed, one or two facts must be borne in mind in order to assure one's self that the conclusions drawn from the facts presented will be properly influenced by a fair estimate of the conditions. These figures reflect data which have been reported from the different plants mentioned, but they have not all been recorded at the same time, as there may be a year, or even two years, of difference, not more, between the earliest and latest of the reports which have been received from the plants mentioned. Naturally, every effort is being always made to improve working conditions and reduce costs, and in some of the plants better results may have been secured since these reports were made. There is no difference of large importance, however, that has been reached in any of the plants, which would tend seriously to alter the figures, and they are, while perhaps not accurate in some cases, so nearly so as to serve very well as bases of comparison.

Tonnage Handled per Day per Man

To begin with, the Homestake mills treat about 4500 tons of material per day. The ore is treated partly as sand and partly as slime, and in the procedure about 275 men are reported to be employed. This gives a total of 16.3 tons per day handled per man employed. Of course, it must be remembered that the Homestake plant is not a homogeneous unit, but consists of various works built at different periods and distributed through a large district. This is a factor which prevents the maximum efficiency, but, on the other hand, there are conditions which tend in the other direction. These are the enormous scale of working, which permits of economies not available to the ordinary small plant, and the system of slimes treatment, which is in Merrill presses requiring very little labor for their operation. These presses, as it is well known, are filled, treated and discharged mechanically, and the only labor required is the careful superintendence of the operation and an occasional cleaning of filter cloths.

Perhaps as an example of what can be done in a plant similarly designed and worked, but of one compact, good-sized unit, we can refer to the Pittsburgh Silver Peak mill at Blair, Nev. This mill treats 520 tons per day by exactly the same system in use at the Homestake mill, with perhaps some minor variations, but in general the same plan. Crushing is in water and sands and slimes are treated separately, sands by leaching and slimes by treating in the Merrill filter press, just as at the Homestake. The Pittsburgh Silver Peak mill employs 22 men. This results in a unit of 23.3 tons treated per day per man. This factor is an extremely high one, and reaches nearly the maximum of ordinary work. One or two of the most modern systems may be able to equal or perhaps slightly exceed this figure, but it is one that is extremely hard to improve.

The Wasp No. 2 mill, in the Black Hills, presents a totally different example of ore handling. As is well known, this mill crushes 500 tons of ore per day through rolls to pass about a ¼-in.-mesh screen, and leaches this product, without further grinding, in large tanks. Twenty-five men are employed, giving a unit of 20 tons per day per man.

An Old Separate Treatment Plant

As an example of a plant of the older type crushing with stamps, regrinding to a certain extent, leaching the sands produced and treating the slimes by agitation and filtration, attention may be called to the Desert mill, at Millers, Nev. This mill has recently been changed into a more modern plant, but reference is here made to the system employed before the change was made. The mill handled 500 tons per day and required 64 men for its operation, resulting in a unit of 8 tons per day per man. It is to be noted that this mill had all the disadvantages of old-type of design, treatment of slimes in mechanically agitated tanks, a vacuum leaf-filtration system, and a flat mill site, which made necessary the use of many elevating devices, such as pumps, elevators and even tailings wheels. Labor was also required in handling the tailings discharged due to the flat nature of the country.

At the Black Oak mill, Soulsbyville, Calif., a modern, all-slime plant built upon an inclined mill site, and treating 85 tons per day, seven men were required, giving a labor factor of 12.1 tons per day per man. At the Goldfield Consolidated mill, which is well known as an all-slime plant, 952 tons are treated daily, with 53 men, giving a labor factor of 18 tons per day per man. This is without considering the concentrates-treatment plant, which of course must be considered as a separate item. If the concentrates-treatment plant is included, the unit is reduced to 13.6 tons per day per man. In keeping with the other plants mentioned, however, it is fair to consider only the mill itself without the concentrates plant, since all the others are considered without accessory or auxiliary institutions, thus giving us the figure of 18 tons.

Effect of Grinding in Chilean Mills

At Stratton's Independence mill, at Cripple Creek, Colo., about 10,000 tons are treated monthly, the grinding being done in chilean mills and the treatment being separate. The sands are given a light leaching and the slimes treated by agitation. Here 35 men are employed in the mill, giving a unit of 10 tons per day per man. At the Liberty Bell mill, Telluride, Colo., the figure was 13.1 tons per man per day before recent improvements were made in the mill treatment-system. At the Montana-Tonopah mill at Tonopah, the factor was 7.4 tons per day per man, and at the Nevada Hills, at Fairview, 6.5 tons per man per day.

The Tom Reed plant, at Oatman, Ariz., had a factor of 9.4 tons per day per man, the Nevada Wonder, at Wonder, 7.33 tons per day per man, and the West End Consolidated, at Tonopah, a factor of 8 tons per day per man.

It may be seen from these figures that, as a rule, the large plant has an advantage over the small one in the number of tons milled per employee per 24 hr. The old-style plant, if it may be typified by the Desert mill before its recent change, may be called one of the most inefficient types from this point of view. Other plants have a somewhat lower factor of labor treatment, but they are much smaller plants and are built without the most modern conveniences.

Amount of Power Used

The matter of labor in cyanide plants is important, but not more so than the question of power consumed for the work accomplished. It should be unnecessary to remark that power requirements are influenced by as many different conditions as are the labor requirements. Plants of the older type usually require more power than the modern ones, but while the plant operated on a large scale may require somewhat less power than the small one, the difference is not so great as might be expected, since about the same amount of power is required to treat a ton of ore whether the plant be large or small, always provided the same system is followed in each case.

The question of mill design does make a very great difference in power consumption. It may be noted that, generally speaking, the mill which uses stamps as crushing machines requires more power than the mill which uses breakers and rolls in series, and chilean mills for grinding. It is also to be noted that the all-slime mill must require more power per unit than the mill making a separate treatment of sands and slimes. The fact that one mill requires more power than another one, or more labor, is by no means condemnatory of the milling practice, since its power and labor expense may be more than offset by an additional recovery which makes the high cost of power or labor quite justifiable.

Some idea of the comparative consumption may be had from the fact that Stratton's Independence mill, Cripple Creek, using chilean mills, consumes only about 1 hp. per ton of ore crushed per day, possibly a little less, while at the Desert mill, using stamps and regrinding, 1.54 hp. was used per ton of ore milled per day. The latter factor is exactly the same at the Black Oak mill, which is much smaller, but is a much more modern type of mill. At the Montana-Tonopah 2.28 hp. was used per ton of ore milled per day, and at the Nevada Hills, 2.12. The Goldfield Consolidated mill required 1.77 hp. for each ton milled, not taking into account the concentrate plant, as has been heretofore explained. The West End mill, at Tonopah, used 2.33 hp. per ton milled, and the Nevada Wonder used 2.09. The Vulture mill, at Wickenburg, Ariz., used 1.6 hp. per ton of ore milled per day.

As has already been mentioned, it must be fully borne in mind that the figures presented, while representing the best available information, must not be taken as absolutely accurate at the present time, since changes may have been made which might alter the factor somewhat. The figures in cases of both labor and power are, however, extremely interesting as affording an indication of what may be expected in the different types of mills, operated in different ways and in different countries. The plants mentioned here are all in the United States but the figures do not differ widely, at least as far as power consumption is concerned, in the plants in Canada and in Mexico. In both these countries, as has already been explained, the labor unit is perhaps quite different, since in Mexico, especially, the native labor is not efficient and will not handle as many tons per day as either that in the United States or in Canada. Should Eastern countries be included in the consideration, it would probably be found that they use much more labor.

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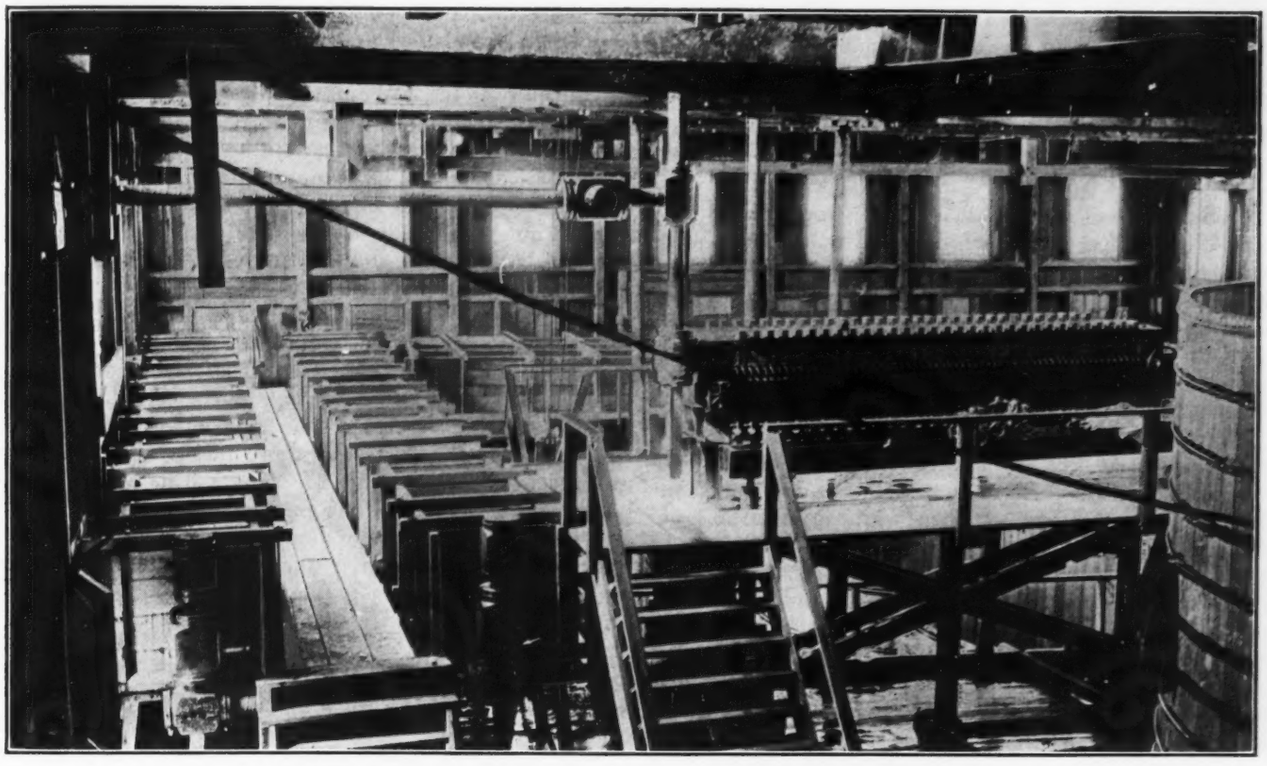
"Mineral Lumber" Sounds Like Coining a New Term, writes Robert N. Bell, but promises a definite realization through a new process that is being applied to an extensive deposit of short-fiber asbestos in the central Idaho pine forests, on state land in Clearwater County, where an ingenious process has been developed for pulping the mineral and pressing it into any shape. Subsequent furnace treatment affords a fireproof material. Shingles are being produced from this mineral which compete in price with ordinary red-cedar shingles, and the use of building material manufactured from it is likely to result in the establishment of a new and important industry.

Chloridizing Blast Roasting and Leaching--II

By Glenn A. Keep*

SYNOPSIS—Details of leaching and precipitation at the Mines Operating Co.'s mill at Park City, Utah. Testing ores for chloridizing blast roasting and leaching. A series of curves shows the results of extended experiments on the process at the Utah School of Mines.

Leaching at the Mines Operating Co.'s plant is conducted in six Douglas-fir tanks, each 20 ft. in diameter and 12 ft. deep. The wood was not in the least affected by the mill solution, but care should be taken that no solution is allowed to leak on the iron tank bands as this solution carrying copper, silver and lead quickly attacks iron. Douglas-fir 4-in. wood-stave pipe is used to conduct the solution to and from the leaching tanks. Rubber-lined hose is not affected by the solution, and this hose, fitted with an iron screw clamp, is used to control the flow of solution to and from the tanks. The hose is clamped by an ordinary brass hose clamp to a hardwood nipple fitting into the wood pipe at one end and the hose at the other end. Leaching is done with a sodium-chloride acid solution of a specific gravity of 24° Bé. The Baumé readings are taken with a sugar hydrometer. Experiment and experience shows that a 23 to 24° Bé. solution has the best dissolving effect upon silver chloride. If the solution gets denser, say 27 to 29°, an unknown salt crystallizes out in the pipe lines and at the air inlet of the air-lift pumps. These crystals are nearly insoluble and their formation should be avoided by keeping down the density of the solutions. This crystallization, of course, shows up most where the solution is coolest.



An Interior View of the Mines Operating Co.'s Mill

Owing to the corrosive nature of the mill solution, metal work is reduced to a minimum; note the extensive use of wood work, including wooden pipe and fittings. The wooden-frame filter press had to be abandoned for silver precipitation because of clogging difficulties and because of brass screws in the filter frames being replaced by silver.

Solution Should Be Warm, 30° C. or Over, and Slightly Acid

The temperature of the solution should be maintained at 30° C. or above in order to do good work, and also must be slightly acid. If the hot roasted ore is sluiced by solution direct from the roasters to the leaching tanks, no external heat is needed to keep the solution at its proper temperature, except during the winter time in a cold climate like that of Park City. Then an ordinary boiler under 5- to 6-lb. steam pressure will have ample capacity for a 200-ton plant. The steam is blown directly into the solution in the "silver tank" and iron boxes. Following are the ordinary solution temperatures at different places in the Mines Operating mill: Temperature of atmosphere, 17° C.; head silver precipitator, 36½°; tail silver precipitator, 35°; silver tank, 37°; head iron boxes,

*Park City, Utah.

35°; tail iron boxes, 35°; barren tank, 32°; barren at leaching tank, 31°; weak-solution tank, 35½°; nozzles at roasters, 31 degrees.

Mill Solution Should Be Green

A green-colored solution is the sign of good work and sufficient acid. If the acid is totally neutralized the solution becomes white and clear, and "iron oxide" begins to precipitate out giving the solution a reddish color; a solution of this type will not give the desired results. The precipitate of iron will first be noticeable in the iron boxes and if acid is not added, the iron precipitate will appear in all the solution throughout the mill, but disappears upon the addition of acid. A solution carrying 2 lb. of acid per ton of solution will do good work, but if the ore is basic in reaction, then enough acid must be used to neutralize this effect of the ore and to keep the solution slightly acid and maintain a green-colored solution. For several months, pyrite was added to the mix at the Mines Operating mill and enough tower acid condensed from the roaster fumes to keep the solution acid and in good shape. Later no pyrite was used and 60° Bé. sulphuric acid was bought and added to the solution in the barren-solution tank. The amount of acid added per ton of ore varied from 0.5 to 1%, depending on the amount of lime in the ore treated.

No Trouble from Foul Solution

Tests upon mill solution show that it contains from 1 to 2 lb. of iron per ton of solution, and that this amount is practically constant. The iron taken into the solution in the iron boxes is apparently oxidized and precipitated in passing through the leaching tanks, and then carried out with the tailings. The solution contains a small amount of sodium sulphate which crystallizes out as such when the solution is cooled to a low temperature. As the iron boxes are not long enough to make a complete precipitation of lead, the barren solution still contains about 8 lb. of lead, in the form of chloride, per ton of solution. This lead can be precipitated as white crystals of lead chloride by adding water to the solution. There is a slight tendency for some of the lead chloride to precipitate in the sump tanks, perhaps due to the solution becoming saturated with lead chloride. Upon adding NH_4OH to the barren solution a voluminous white precipitate is obtained, probably aluminum hydroxide, although this was not definitely determined. During continuous operation for a period of two years no trouble whatever has been experienced by fouling of solutions at the Mines Operating mill.

In the leaching operations, "weak solution," i.e., solution low in silver, is first run through the ore until the solution carries 3 to 5 oz. of silver when the solution is pumped through the precipitating system. After treatment by weak solution, "barren solution" containing no silver is put through the tank for about 24 hr., which will give a final effluent of not more than 0.2 oz. of silver per ton of solution. The ore is now ready to be washed and water is accordingly run upon the tank, and with a charge of 10 ft. of ore, should continue until the effluent gives a reading of about 8° Bé., when tested with the hydrometer. The water is then shut off and the tank drained, the final effluent of which should run 3° Bé. The total time of washing will be 3 to 4 hr. for a charge of ore 10 ft. deep. It is apparent that water is thus put into the solution and some salt remains in the ore to be discharged with the tailings. The evaporation about the mill takes care of this extra water, and when using 6 to 7% salt in the mix, enough salt remains undecomposed in the roasted ore to take the place of the salt lost in the tailings. It is evident that a minimum of 6% salt will be required for the continuous operation of the process, in order to keep the solutions at the proper strength. No salt, then, will have to be added directly to the solution, as it will be automatically maintained at the proper strength. In case the strength of solutions does tend to vary, it can be easily regulated either by addition of more or less salt to the mix, or by varying the specific gravity of the effluent solutions with the wash water.

Three sump tanks are required: A "silver tank" containing solution rich in silver which is to be passed through the precipitating system; a "weak tank" containing solution low in silver; and a "barren tank" containing solutions from which all the valuable metals have been precipitated with the exception of some lead, which may remain in solution if the iron boxes are not long enough to catch it all or if some other means of precipitation of lead is employed. To the silver tank are run all effluents carrying enough silver for precipitation. This solution is pumped over the silver precipitator where the silver is precipitated upon scrap copper. From the silver precipitator the solution flows by gravity through the iron boxes where the copper and any unprecipitated silver are first thrown down after which lead is precipitated upon the iron. From the iron boxes the solution flows by gravity into the barren tank and is known as barren solution. This barren solution has been reduced in its passage through the iron boxes and is white and clear in color. If acid is to be added to the solution it should be added to the barren solution at this point. The barren solution is pumped directly to the leaching tank which is to be washed and discharged the following day. If acid has been added to the barren solution, the solution will be oxidized in passing through this tank and its effluent will be a deep green color. This green effluent, together with all other effluents running low in silver, is run to the weak tank from which it is pumped to another leaching tank and returned either to the weak tank or to the silver tank, depending upon its silver content.

Bleaching Powder Used with Gold Ores

To make a high recovery upon ores containing gold, 0.25 to 0.5% of bleaching powder should be added to the roasted ore in the leaching tanks as the tanks are being filled. Gold that is not in a soluble form already is dissolved by action of the chlorine generated from the bleaching powder. Liquid chlorine was tried but with unsatisfactory results, it being both hard to handle and dangerous when used in open leaching tanks. If electrolytic precipitation of lead were employed, the chlorine evolved in precipitation would put the barren solution in fine condition for leaching purposes. Probably enough free chlorine would then be carried by the solution to dissolve any gold in the ore without the use of bleaching powder.

Metals Quickly Dissolved

If the ore has been properly roasted the metals go into solution quickly, and if the roasted ore is sluiced by solution direct from the roasters to the leaching vats, two-

thirds of the soluble metals will have been extracted by the time the tank is filled. From 36 to 48 hr. will then be required to finish leaching and washing the tank ready to discharge. If this method of conveying the roasted ore to the tanks is employed, concrete launders must be used. No wood launders should be used for carrying mill solution as the nails or screws will soon be destroyed by the solution, causing the launders to leak. This difficulty cannot be overcome by use of brass or copper nails as the silver in solution replaces both brass and copper.

At the Mines Operating mill, the tailings are discharged by sluicing out with water through a 13-in. round hole in the tank bottom at a cost of 5.6c. per ton. During leaching this hole is closed by a large wooden plug fastened at the end of a 12-ft. piece of 4x4. The plug and its stem are inclosed by a vertical box 2 ft. square and 12 ft. long. This box is fitted with gates at various heights which are removable from the inside, thus making an opening in the box through which the ore is sluiced. In order that the plug may be easily removed, it is set lightly in the hole and caulked with oakum.

Filters made of wood and burlap were used for several months but were discarded in favor of drain-tile filters. This type of filter is made of ordinary 6-in. drain tile having one-half of its surface perforated with small holes. The tile is set in concrete exposing the perforated side to act as a filter. A line of tile is laid through the middle of the tank with four branches extending each way to the sides of the vat. The ends of tile are closed each by a wood plug. These plugs can be removed and a hose used to flush out the filter lines, if necessary. After a vat has been discharged, some of the remaining sand is heaped over the filters and the tank is ready for refilling.

Assay of Solutions

Several methods of assaying the salt-acid solutions for gold and silver were tried and the following adopted as the best: Put 1 a.t. of solution in a 200-c.c. beaker, add 15 c.c. saturated lead-acetate solution and about 50 c.c. water. Heat. Add Al foil and 5 to 10 c.c. HCl. When lead sponge is complete, pour off solution, roll lead into a small ball about ½-in. diameter, dry for a short time and cupel.

Titrating the mill solution for free acid is rather unsatisfactory, because the solution contains iron, aluminum, etc., all of which are precipitated by KOH solution before an indicator will work. The free acid can be approximately determined by titrating with a deci-normal KOH solution until the above precipitates just begin to form. If 10 c.c. of salt-acid solution are titrated with a deci-normal KOH solution, then each cubic centimeter of KOH used will equal approximately 1 lb. of acid per ton of solution.

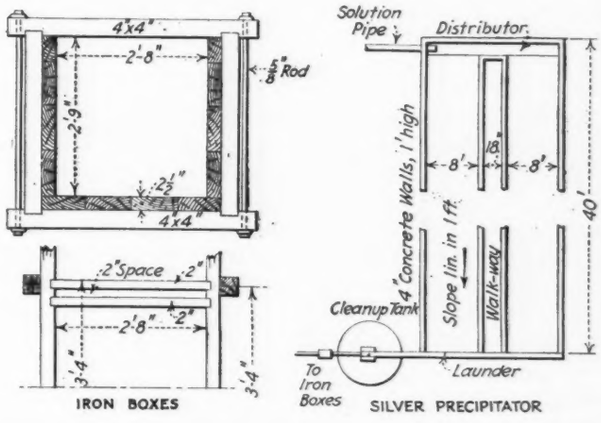
Leaching Cost from 17 to 41c. per Ton

The cost of leaching may vary considerably depending upon whether acid is condensed from the roaster fumes or is bought and added to the mill solution. The cost of leaching operations at the Mines Operating mill, including upkeep and maintenance of pumps, compressor, solution lines, etc., was 40.8c. per ton, which is the average cost for the six months ended Aug. 31, 1914. However, for a period of several months when pyrite was used in the mix and the resulting acid condensed from the fumes, the leaching cost was 17c. per ton in the summer. In the winter this cost was increased to 25c. per ton due to cost of heating the mill solution by steam. Later when no pyrite was added to the mix and no acid made in the mill, 60° Bé. sulphuric acid was bought and added to the mill solution, thus augmenting the cost of leaching 15 to 20c. per ton. About one-half of the 40.8c. cost per ton given above was for acid.

Precipitation

The silver precipitator is an inclined plane surface, 16 ft. wide and 40 ft. long, with a slope of 1 in. per ft. It is walled in on there sides and surfaced with concrete 4 in. thick. The surface is covered with scrap copper such as wire, sheets, etc., and requires only about 3000 lb. of copper, so that it is not necessary to tie up capital in a large supply of copper. The silver solution is distributed evenly across the head end and flows in a wide thin stream over the scrap copper into a concrete launder. This launder leads to the cleanup tank, a small tank 8 ft. in diameter by 10 ft. high. The solution can be run either direct to the iron boxes or to the bottom of the cleanup tank, the overflow then going to the iron boxes.

An advantage of this type of precipitator is the quickness and ease with which it can be cleaned up. The silver



precipitate is white in color and extremely fine, but unless disturbed it sticks together and builds upon itself to considerable depth. When disturbed it breaks up into a fine slime and floats away. When a cleanup is to be made, the silver-solution pump is shut off and the silver is sluiced by use of a water hose into the cleanup tank which has previously been drained. Two or three men are employed to rake over the scrap copper with brooms or hoes, the water carrying the silver slimes into the cleanup tank. The whole operation takes only about 20 min. A silver cleanup is made twice each month and additional scrap copper is placed on the precipitator at each cleanup. About 2 lb. of copper are consumed in precipitating 1 lb. of silver. This precipitator will precipitate 90% of the silver from 400 tons per 24 hr. of solution carrying 3 to 4 oz. silver per ton.

The silver precipitate carries 50 to 60% silver, some sodium chloride and some gases, probably oxygen or chlorine. It is washed with water, dried, and is then easily melted into silver bullion, with addition of about 15% borax glass only. A Case oil-fired tilting furnace is used for melting, and bullion assaying 950 to 980 fine is obtained.

The copper going into solution upon the silver precipitator, together with the copper extracted from the ore, is then precipitated upon scrap iron in the iron boxes. The iron boxes are built similar to the zinc boxes ordinarily used in the cyanide process, but are much larger. There are two rows of iron boxes, each containing 28 boxes; each box is 3 ft. 4 in. long, 2 ft. 8 in. wide, and 2 ft. 9 in. deep. Probably an iron box could be designed which would be easier to clean up than those just described. The iron boxes are cleaned up once each month, the precipitate being washed with water to free it from sodium chloride, then dried, sacked and shipped to smelters.

Melting the copper precipitate in the tilting furnace and making granulated copper for use on the silver precipitator was tried. The granulated copper thus obtained proved satisfactory, but the wear on the graphite crucibles was so great that it is cheaper to sell the copper precipitate and buy scrap copper.

After the copper has been precipitated out of solution, lead comes down upon the iron but the iron boxes are not long enough to make a good precipitation of lead, there being about 8 lb. of lead per ton of solution in the iron-box tails. Cast iron is a much better precipitator of lead than any other iron, probably due to the carbon in the iron. The iron-box tails carry no copper and only a trace of silver. From these chloride solutions 1 lb. of iron is consumed in precipitating 1 lb. of copper.

Electrolytic Action as Precipitate Accumulates

On the silver precipitator and in the iron boxes the precipitate builds upon itself to a depth of 6 to 8 in., precipitation being carried on by electrolytic action, due to a couple set up by two different metals in a slightly acid solution. This is shown conclusively by placing a long copper wire in the iron boxes, one end in contact with the iron and the other end extending into the solution. Copper will be deposited upon the entire length of the copper wire, while the wire itself is not attacked.

To obtain good precipitation the solutions must be kept warm, not less than 30° C., and slightly acid. If the solution becomes neutral, iron oxide will be precipitated throughout the iron boxes, which will, however, go back into solution upon making the solutions slightly acid. If the solution becomes cold, action will slow down, and precipitation will be incomplete.

Lead can be readily precipitated from the barren solution by an electric current, using carbon and lead electrodes. Chlorine is evolved and the solutions put in good shape for use in leaching. However, this was determined only in an experimental way using wet batteries and jars as precipitating vats.

The total cost of precipitation and cleanup including drying and sacking the product is 5.1c. per ton of ore treated. The cost of refining the silver precipitate in the Case tilting furnace is 8 to 10c. per ton of ore treated. Before the silver precipitator was put in operation, the silver, copper and lead precipitates were mixed and sold to smelters. However, the smelters claim that this mixture of precipitates is exceedingly hard to handle on account of its high silver contents. Hence it was decided to separate and refine the silver at the mill and sell the silver bullion, which operation nets about 1c. more per ounce of silver produced.

At the beginning of operation at the Mines Operating mill, precipitation of silver upon cement copper in a wooden filter press was attempted but soon discontinued. The plan was to use the cement copper from the iron boxes in the filter press to precipitate silver. The cement silver, together with the salt in solution, would soon render the filter cloths impervious. Also the solution soon destroyed the brass screws with which the wooden filter frames were fastened together.

Compressed-Air Pumping Adopted

Pumping salt-acid solution containing silver and copper in solution proved a rather difficult problem. Centrifugal pumps made of bronze, in handling a solution rich in silver, have had their casings worn out in less than 40 hr. of continuous pumping. This rapid wear is not due to action of acid, but to silver in solution precipitating and replacing the metals of which the pump is constructed. This precipitation of silver is rapid in a centrifugal pump where the agitating and scouring action of the pump always presents a clean surface upon which the solution can act. Experiments were made with a wooden Cornish pump and a wooden plunger pump. Although both these pumps worked, neither was a success on account of frequent breakdowns and excessive repair work, all of which interfered with smooth operation of the mill. The problem was successfully solved by the use of the ordinary Pohlé air lift. The lifts are made of Douglas-fir wood-stave pipe, using large solid wood ells and tees. Air is conducted from the main air line to each pump by a rubber-covered and rubber-lined hose.

There are five of these air lifts in the Mines Operating mill. Air is furnished by one 12x12-in. compressor, requiring 28 hp. and furnishing air at 25 to 30 lb. pressure. The five pumps are used for the following purposes: One pump pumps the rich silver solution to the silver precipitator; another takes the barren solution to the leaching tanks, and three working in relays pump the weak silver solution either to the leaching tanks or to the roaster for use in sluicing the roasted ore from the roasters to the leaching vats. The first and second pumps are constructed of 3-in. wood pipe and handle 400 to 500 tons of solution per 24 hr. The last three pumps are constructed of 4-in. wood pipe and handle approximately 1000 to 1500 tons per 24 hr. The first two have a submergence of 50% and the others a submergence of 60%. These pumps handle the solution in a satisfactory manner; however, it is well to point out that no solution should be allowed to leak on the iron pipe bands; also, as said before, the density of the solution should be kept near 24° Bé. to prevent crystallization of an unknown salt in the pump lines, but more especially in the air hose at the point where the air enters the pump.

Suction Fans with Concrete-Covered Blades

Trouble was experienced in finding a suction fan to handle the roaster gases especially when pyrite was used in the mix. These fumes are warm and contain much water vapor and small amounts of chlorine, sulphur fumes, hydrochloric and sulphuric acids. Fans with both iron and brass runners were discarded on account of the corrosive action of the gases on these metals. If the gases were hot, as from Dwight-Lloyd sintering machines, it is possible that iron would then resist this destroying action. However, this is doubtful on account of the chlorine present in the fumes from a chloridizing roast. A fan made entirely of hardwood, fastened together by

wooden pins, did good work for six weeks. Then the wood runner became soft and rotten and was consequently wrecked by centrifugal force.

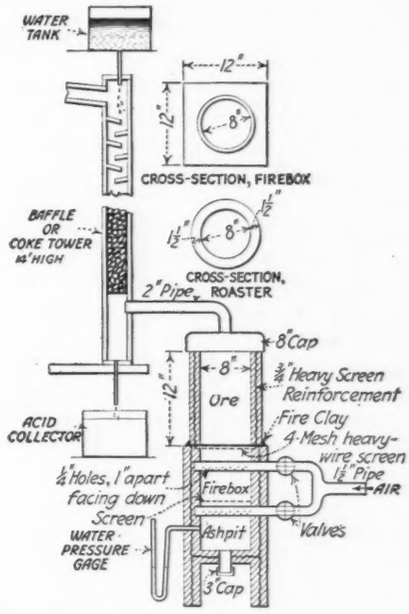
A fairly satisfactory fan was then designed and put in operation. The housing of this fan is built of 4-in. fir. The ends of the housing are constructed of 4x12-in. lumber and are dapped into the circumference which is made up of 4x6-in. lumber. The housing is held together by two ¾-in. iron bands encircling the circumference. The runner which is 52 in. in diameter has five blades, each fastened to two 3-in. T-irons, which are cast into two cast-iron hubs. The blades, 29 in. long by 19 in. wide, are made of ¼-in. sheet steel, and are drilled with $\frac{5}{16}$-in. holes spaced 4 in. apart. When the runner has been assembled, the shafting inside the housing, the cast-iron hubs and the T-irons are all incased in concrete. Rainbow-gasket sheet rubber, ⅛ in. thick, is bolted to the face of each blade. This rubber facing lasts from four to six months when it begins to stretch and bulge and finally cracks, due to air getting between the blade and the sheet rubber. The rubber, however, seems to have its usual toughness and appears in good condition. The rubber facing is replaced and the fan is again ready for use. Heavy wood blades, 1½ in. thick, were given a trial on this type of fan, but soon became water-soaked and soft. Several acid-proof paints were tried but none proved satisfactory. A promising material for fan blades is a rubber-covered sheet iron to which the rubber has been vulcanized. A set of five blades with ⅛-in. rubber cover, vulcanized on both sides, will cost $45, and would no doubt wear a long time, although no trial has yet been made. The fan now in use requires 6 hp. when running 300 r.p.m., and will handle satisfactorily the fumes from three 10x10-ft. blast roasters, using a ¾-lb. blast of air on a 6-ft. bed of roasting ore.

Testing Ores

A small roaster for testing purposes can be easily constructed where air under pressure is available. The accompanying drawing shows such a roaster and is self-explanatory. The reinforcement for the concrete is heavy wire screen with ¾-in. openings, which should be lapped and thoroughly wired together to prevent both the roaster and firebox from cracking.

In conducting a roast, pieces of wood 3 or 4 in. long, are placed upon the lower screen to a depth of 8 to 10 in. The wood is ignited and a small amount of air turned into the lower blast pipe. The upper screen and empty roaster are then put in position, a little fireclay being used to cement the crack between the roaster and firebox. More air is then turned into the lower blast pipe, and some air in the upper pipe. When the upper wire screen is heated to redness, the air blast is turned down slightly and 3 to 4 in. of the prepared mix of ore, fuel and salt are charged into the roaster on top of the red-hot screen. When the ore has been evenly ignited and is roasting satisfactorily, the remainder of the mix is charged into the roaster, the lower air blast is shut off and the proper amount of air admitted through the upper blast pipe. A U-shaped glass water-pressure gage can be used to determine the amount of air pressure, about 1 in. of water pressure being required after the roast has received a good start. However, with a little experience the proper amount of air can be readily regulated by noticing the fumes coming off the top of the ore. At first the fumes will be dense due to the wood smoke, but after the wood has ceased burning, the fumes may be hardly noticeable. However, the ore is roasting, which fact can be tested by feeling the heat coming up through the ore. If the ore contains sulphides, some of the sulphur will be distilled off ahead of the roasting zone and sublimed in the green ore near the top. Therefore when the zone of roasting nears the top the fumes will become dense and smell strongly of chlorine and sulphur gases. The rate of roasting should be about 1 ft. per hr. With a little experience the temperature of the roast can be judged closely by noticing the red glow of the ore as the roast breaks through on top. The roast should be left to cool in the roaster to allow as much time as possible for chloridization to take place.

In preparing ores for roasting tests it is well to begin by crushing the ore through an 8-mesh screen. As the roast is on a small scale, it is well to crush pyrite and salt finer than 8-mesh, say through a 20-mesh screen. When no fuel is present in the ore itself, such as pyrite, run the



Test Roaster for Chloridizing-Leaching

following series of tests, using 10% of sodium chloride in each roast:

TEST ROASTING CHARGES

Ore, Lb.	Coal, %	Pyrite, %	NaCl., %
20	3.0	0.0	10.0
20	2.8	1.0	10.0
20	2.6	2.0	10.0
20	2.2	3.0	10.0
20	1.8	4.0	10.0

The various reagents should be weighed on a set of scales and thoroughly mixed dry; then 7 to 10% water added and again thoroughly mixed. The amount of moisture required will vary with different ores but should be enough to make the mix feel damp and so that it tends to stick together when squeezed in the hand. As the bottom 3 to 4 in. of the roasted ore are never well chloridized, this part of the roast should be discarded before taking samples for leaching tests. The above proportions will give good roasts upon most ores, but the temperature may have to be regulated by cutting down on the percentage of coal added. Also care should be exercised in regulating the

air pressure, the tendency being to force the roast by using too much air.

The series of tests outlined ought to give an indication of what extraction is to be expected. It is well to supplement these tests with a series showing the effect of coarser and finer crushing. If the ore is to be leached with a 24° Bé. salt-acid solution, then roasts should be made with varying percentages of salt, from 6 to 12%, to determine the amount of salt required. If the test is upon a copper ore to be leached with a weak acid solution or upon an ore which is to be treated with cyanide after roasting, then a series of roasts containing 2 to 10% salt should be conducted, as 2 to 5% salt will likely give the desired results.

However, in doing the roasting on a commercial scale in a roaster containing a deep bed of red-hot ore, chloridizing conditions are much more favorable than in the experimental roaster. Consequently the amount of fuel required is less, the crushing can be considerably coarser, and the amount of salt needed is 1 to 3% less than the experimental tests indicate. Where a 24° Bé. salt solution is used for leaching, a minimum of 6 to 7% salt in the roast will be essential in order to keep the solution at its proper density without adding any salt to the solution itself, the strength of solution being maintained by the undecomposed salt in the roasted ore. In the amount of acid produced by the roast is not determined, the test roaster can be run with an open top and the progress of the roast readily inspected.

The acid in the fumes can be condensed by passing the roaster gases through a baffle or coke tower in which water equal to twice the weight of the roasting ore is slowly passed and returned through the tower twice during the time of roasting. The amount of acid thus produced is determined by titrating with a deci-normal KOH solution using a phenol indicator. Of course, the condensation of the acids in the fumes is imperfect, but will compare favorably with similar work on commercial scale.

Leaching Tests

Leaching tests are made in glass percolators, using a wood-and-cloth filter bottom. One kilogram of the roasted ore is charged into a percolator and leached with 6 kg. or liters of salt-acid solution. This solution is a 24° sodium-chloride solution with 7½ c.c. sulphuric acid added to each liter of solution. If the ore assays high in copper, 1 to 1½% acid should be added in making the solution, which in all cases should be heated in a glass or porcelain dish to at least 40° C. before using for leaching.

The ore is percolated slowly for 6 to 8 hr., the solution being used once and not returned through the ore a second time. After leaching, the ore is washed with 1 to 2 liters of water. The rate of extraction is extremely rapid, and the first liter of solution through the ore will likely contain 50% or more of the metals. In leaching an ore containing gold, use 0.25 to 0.5% bleaching powder (chloride of lime), one-half of which is mixed with the ore in the percolator and the other half with the solution. The time of leaching for gold should be extended to 16 to 24 hr. if a good extraction is not obtained upon a short-time leach. The roasted ore loses from 5 to 10% in weight during leaching, which loss should be taken into consideration in computing the extraction of metals. If the testing work is to be extensive, the solution used in the leaching tests should be saved and its metals precipitated on iron, thus making a barren solution which, after addition of acid, should be used in all subsequent leaching tests. This barren solution containing some iron will give better results than a freshly made salt-acid solution. For the same reason mill solution used for testing work gives better results than a newly made solution.

In testing a copper ore containing only a small amount of silver, a dense salt-acid solution is not necessary as the extraction of copper depends upon the acid in the solution and not upon the salt. After a chloridizing roast in a blast roaster, all the soluble copper is soluble partly in hot water and the remainder in a very weak acid solution, but none is soluble in a hot salt solution after the ore has first been treated with hot water. The total copper extraction can, therefore, be determined by leaching with a hot weak-acid solution containing 1 to 1½% acid. If desired, the amount of water-soluble copper can be determined by leaching with hot water before the weak-acid leach. Enough salt remains undecomposed in the roasted copper ore to extract a small amount of silver if such be present in the ore.

Experiments at Utah School of Mines

The curves shown in the accompanying charts are taken from experiments conducted in 1911 by Robert J. Goodwin under the School of Mines fellowship, and by me, working under the Col. E. A. Wall fellowship at the research station of the Utah State School of Mines at Salt Lake City, Utah. This station is at present conducted jointly by the U. S. Bureau of Mines and the State of Utah, and research work is now being done there upon chloridizing and leaching zinc and lead, so some definite results upon these metals should soon be obtained.

Tower Acids

A series of tests were conducted to determine the character and amount of acids resulting from chloridizing blast roasting of ores containing varying percentages of pyrite and chalcopyrite. The ore was roasted in a small roaster similar to the one which has been described and the fumes condensed in a 4x4-in. coke tower. The ore was prepared by adding different percentages of 60-mesh pyrite and chalcopyrite to quartzite which had been crushed through a 10-mesh screen. In each roast 10% salt was used.

Plate I shows the strengths of the acids in terms of pounds of acid per ton of tower acid produced by roasting one ton of ore. The amount of sulphuric acid in the tower acid was determined by weighing the precipitate obtained upon addition of barium chloride to the tower acid. We found that the amount of sulphuric acid produced was nearly constant for the different percentages of sulphides in the ore. Accordingly the percentage of sulphuric acid, as compared to the total acid produced, rapidly decreased with increasing percentages of sulphides from 43.5% H_2SO_4 in case of 2% pyrite to 2.5% H_2SO_4 when the ore was roasted with 10% pyrite. This fact indicates that sulphuric acid produced in the roasting zone reacts with the salt to give hydrochloric acid and salt cake in the tower acid. It was found that gangue material has much to do with the amount of acid produced by a chloridizing roast and that porphyry gangues, especially a clayey gangue like a decomposed porphyry, are better producers of acid than quartzite. In some cases the acid

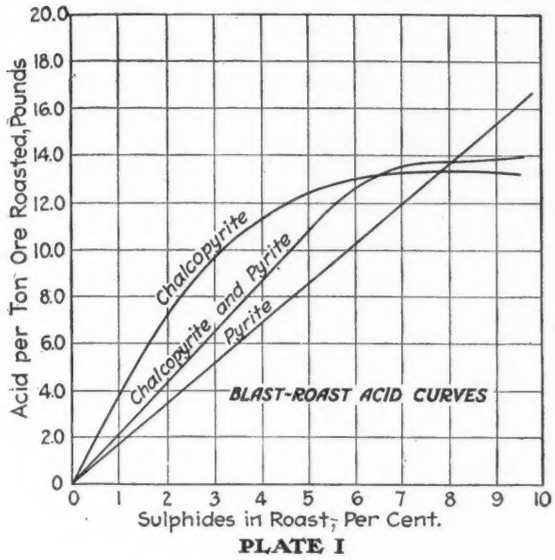


PLATE I

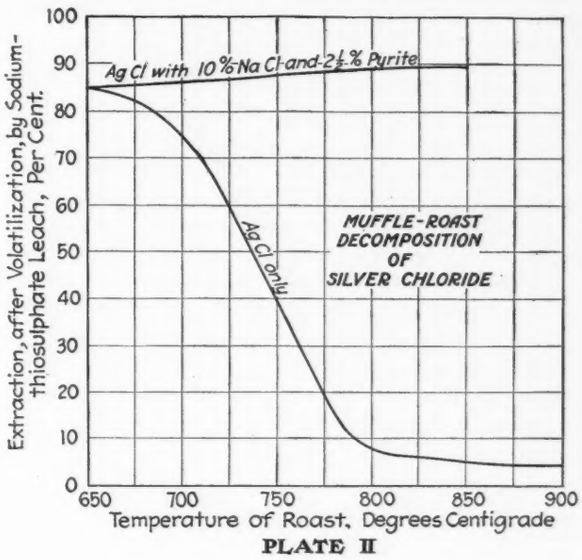

Extraction, after Volatilization, by Sodium-thiosulphate Leach, Per Cent.
Ag Cl with 10% Na Cl and 2½% Pyrite
Ag Cl only
MUFFLE-ROAST DECOMPOSITION OF SILVER CHLORIDE
Temperature of Roast, Degrees Centigrade

PLATE II

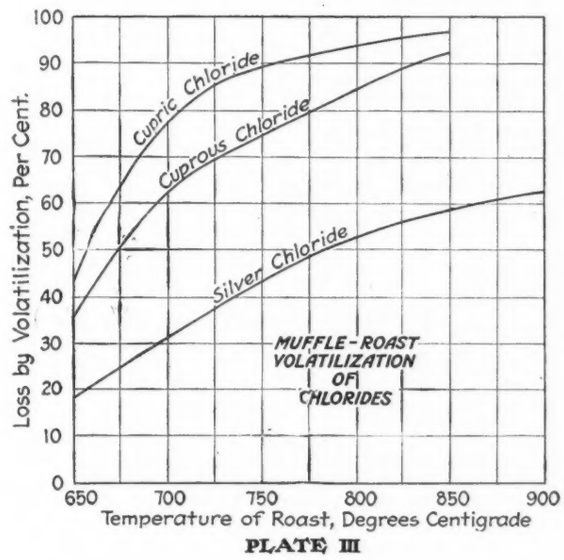


PLATE III

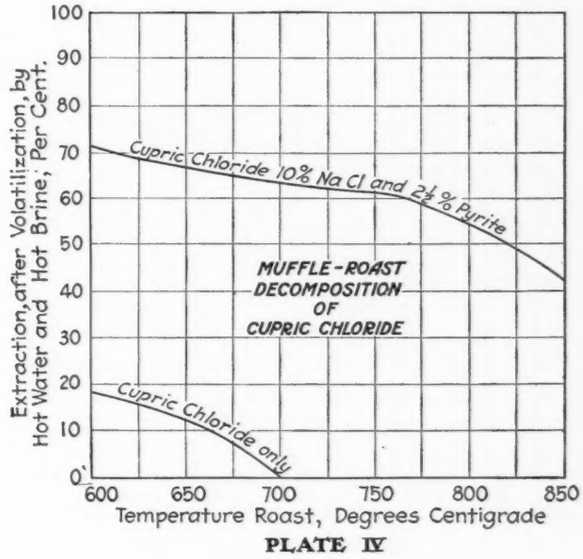

Extraction, after Volatilization, by Hot Water and Hot Brine, Per Cent.
Cupric Chloride 10% Na Cl and 2½% Pyrite
MUFFLE-ROAST DECOMPOSITION OF CUPRIC CHLORIDE
Cupric Chloride only
Temperature Roast, Degrees Centigrade

PLATE IV

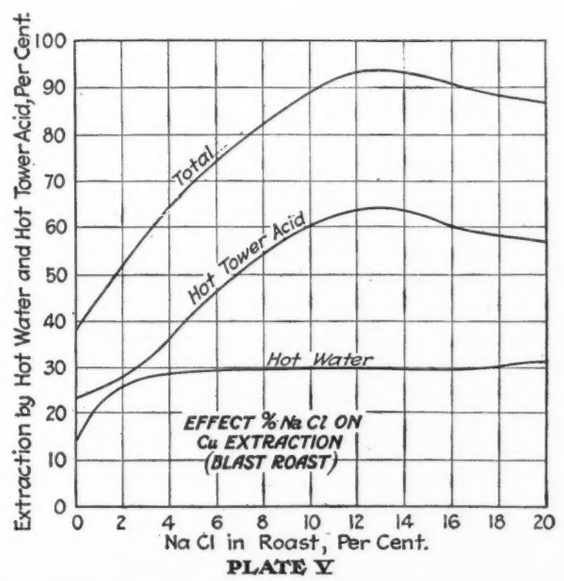

Extraction by Hot Water and Hot Tower Acid, Per Cent.
Total
Hot Tower Acid
Hot Water
EFFECT % Na Cl ON Cu EXTRACTION (BLAST ROAST)
Na Cl in Roast, Per Cent.

PLATE V

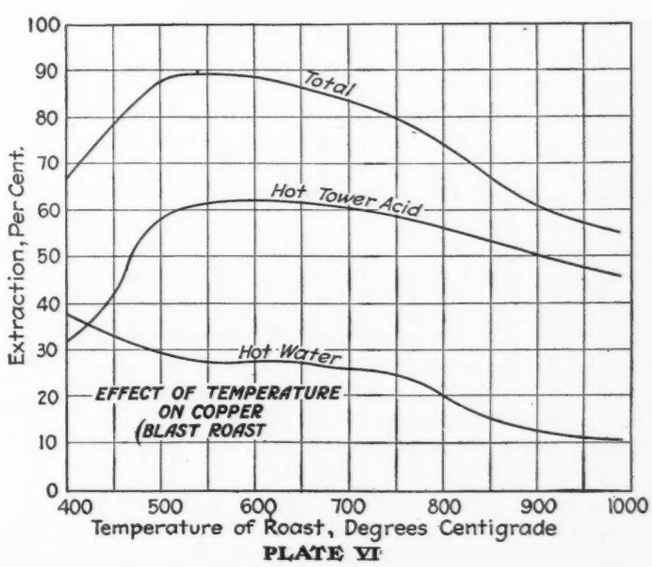


PLATE VI

CURVES SHOWING RESULTS OF CHLORIDIZING-LEACHING TESTS AT UTAH SCHOOL OF MINES

made from such gangues would be three to four times the amount indicated by Plate I.

Volatilization and Decomposition of Chlorides

A series of tests was conducted upon silver and copper chlorides to determine the rate of volatilization and decomposition of the chlorides. These tests were made in roasting dishes placed in the assay muffle for 30 min. The temperature of each roast was taken by a pyrometer, the points of which were placed directly in the roasting ore. Plates II and IV show the condition of the silver and copper remaining in the ore after loss by volatilization. The silver curve indicates that silver chloride decomposes rapidly between 700 and 800° C., when a chloridizing atmosphere is not maintained in the roasting ore. Therefore a chloridizing roast to be successful must contain enough salt not only to chloridize the silver but to maintain the chloridizing conditions throughout the time the ore is heated to a high roasting temperature. The silver curve based on roasts containing 10% salt and 2½% pyrite shows forcibly the effect of maintaining a chloridizing atmosphere. In this case 90% of the silver remaining in the ore after volatilization is in the form of silver chloride at the high temperature of 850° C. From Plate IV it may be seen that cupric chloride at temperatures above 600° C. decomposes even in a chloridizing atmosphere, and that this decomposition is rapid for temperatures over 700° C. This plate also shows that cupric chloride alone is completely decomposed at 700° C. into copper compounds insoluble in either hot-water or hot-brine solution. The feature of Plate III is the rapidity and completeness of volatilization in cases of cupric and cuprous chlorides.

Chloridizing Copper

Tests were made to show the condition of copper after chloridizing the ore in a blast roaster. A typical copper porphyry ore was roasted in the test roaster, temperatures being taken by a pyrometer, the points of which were placed in the center of the roasting ore bed. The ore from each roast was leached first with hot water, and then with tower acid produced in the roasting process and condensed in the coke tower. For each pound of ore roasted 3 lb. of tower acid were made, varying in strength from 3 to 12 lb. of acid per ton of tower acid. Special attention is here called to the very weak acid solutions, containing in most cases less than ½% acid, which were employed in these leaching tests. Referring to Plates V and VI, it can be seen that approximately 30% of the copper is soluble in hot water. Addition of more salt to the ore being roasted did not increase the percentage of copper soluble in water. High temperatures reduced the amount of copper soluble in water. The copper which is soluble in water is evidently in the form of cupric chloride and copper sulphate. After leaching with hot water, no further extraction of copper could be obtained by a hot-brine solution which indicates that no cuprous chloride is formed in the ore during roasting. However, it is possible that cuprous chloride would be extracted by the hot-water leach as there always remains in the ore after roasting some undecomposed salt which would make a very weak salt solution. The copper which is soluble in the very weak acid solution is probably in the form of copper oxide and oxychloride of copper. A fact of importance is that practically no iron was extracted from the ore by the hot-water and weak-acid solutions, and, therefore, these solutions are in ideal condition for precipitation upon scrap iron. It has been proved by commercial operations that 1 lb. of iron will precipitate 1 lb. of copper from these chloride solutions, and that there is no tendency for the solution to become foul by accumulation of iron in solution. The tests just outlined were not made with the intention of obtaining high extractions as no pyrite was added to the ore and the weak tower acids were in each case employed for leaching. Tests made upon this ore and other similar ores, using 5 to 8% salt in the roast, and leaching with a 1 to 1½% acid solution, have repeatedly given extractions of 96 to 98% of the copper contained in the ore on 8-mesh crushing.

A Copper Discovery in Norway

By A. D. Udhany*

A discovery of copper ore, which promises to be of considerable importance has been recently made on the island of Karmoen, which is on the southwest coast of Norway, in the neighborhood of the town of Stavanger. The discovery of the deposit was made by George Hopkins, an English mining engineer, who has lived and worked in Norway for 15 years past. So far five lodes have been located, running nearly parallel to each other in a hill which rises from the water edge rather sharply to a height of 400 meters. Near the surface these lodes vary from 4 to 15 meters in width.

Samples taken over a considerable range have been assayed at Christiania and found to carry from 4 to 8% copper, with about 50% sulphur. The ore is also free from zinc and from arsenic. The showing so far made is quite sufficient to warrant an expenditure for further exploration. It is intended to carry this out at once by running in an adit to cut the lodes at varying depths. This can be done at moderate cost, as cheap water transportation is available for all materials. The deposits are close to the sea and there is a good harbor. The owners of the mineral claims have secured sufficient land for the location of docks, storehouses and other buildings.

These deposits are in the neighborhood of the Vigsnaes mine, formerly the most noted copper mine in Norway; and it is not improbable that the deposits are continuations of the Vigsnaes orebody.

In connection with this discovery some account of the neighboring Vigsnaes mine will be of interest. Work in that mine was started in 1865. The original owners were English, but the mines were afterwards sold to a Belgian syndicate for £2,000,000. From 1870, when the mine was fully opened, to 1880, work was carried on upon a large scale, as many as 600 men being employed. From 1880 to 1890 it was actively continued, but with a smaller force. From 1890 the force was gradually decreased, and in 1894 the mine was closed altogether. The reasons for this were the depth of the workings, which was then 735 meters vertically, and the fact that the copper contents of the ore were found to diminish with increased depth. Thus the cost of mining increased while the return was lowered and the mine ceased to be profitable.

During the 29 years of its life about 900,000 tons of ore were taken out, which averaged 3.75% copper. It was estimated by the engineer that about 700,000 tons more could be taken out if the work was continued down to 1000 meters, but the return in copper would be much less.

*Christiania, Norway.

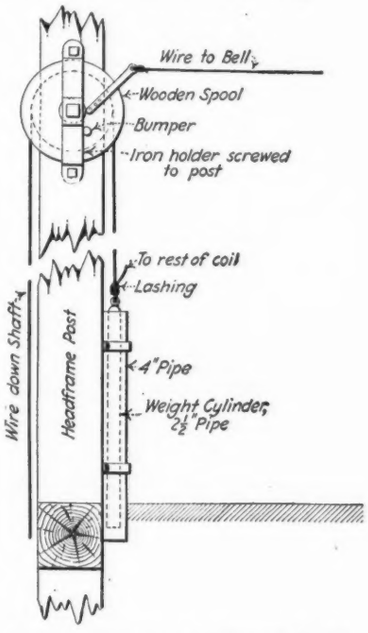
Details of Practical Mining

Bell-Wire Arrangement in Sinking

By Clinton P. Bernard*

In shaft sinking it is necessary to carry down the signal-bell wire or rope as depth is gained. In shafts over 200 to 300 ft. deep, it is common to use a heavy wire or wire rope from the surface to a point about 50 ft. from the bottom, and a rope for the rest of the way. There are numerous ways of arranging the wire and bell at the surface, but the one described here is simple and has many advantages.

The wire is wrapped three or four times over a wooden spool attached to the post of the headframe, then passed through the handle of the weight cylinder, lashed, and the rest of the coil hung in some convenient place. The weight cylinder is a piece of 2½-in. pipe with a cap on the bottom, filled with scrap to give the desired counterweight. This weight cylinder moves in a 4-in. pipe, outside the collar set and extending, for convenience, about 3 ft. above the ground. A bumper on the spool permits it to revolve just enough to actuate the bell through a wire fastened to an arm on the spool.



Arrangement of Signal Pull-Wire at Shaft Collar

The shaft wire may be lengthened as desired, by unfastening the lashing above the weight cylinder, and allowing the required length of wire to slip over the spool, thus doing away with splicing. No springs are required and there are no weights to dislodge and fall into the shaft. By adjusting the counterweight, the pull on the wire need be but a few pounds through 3 or 4 in. The entire outfit can be made in a short time, at small expense.

Burning Empty Dynamite Cases†

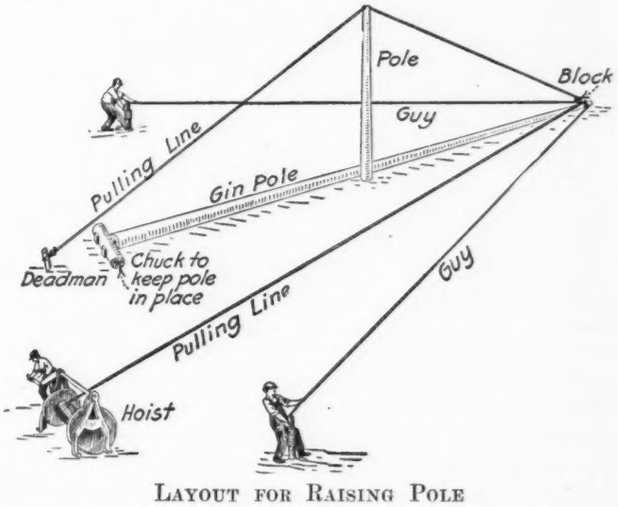
Dynamite, when spread out on the ground so as to expose as large a surface as possible, and ignited, generally burns up peacefully without exploding. The presence of metallic articles, like wire, nails (and of course blasting caps), etc., makes an explosion likely. It is therefore wise when destroying dynamite to take it out of its wooden case, on account of the presence of the nails in the latter.

The cases should be burned separately, since when they become saturated or stained with exuded nitroglycerine they almost always explode when burned, but if no dynamite is mixed up with them there is generally not enough of an explosion to do any great damage. To set fire to them, soak a little excelsior or waste in gasoline and put one end of a piece of fuse in this, being careful to light the outer end first. Have the fuse 2 or 3 ft. long and the waste or excelsior under the empty dynamite cases. Or lay a train of excelsior and light one end with a match and run.

Dynamite cases showing any signs of being stained should never be used for fuel but should be promptly destroyed in the manner described. If they blow up in the open with everybody at a safe distance they will do no harm, but if they blow up in the kitchen stove, somebody will probably be badly hurt or killed and the house burned down.

Raising a Gin Pole

In Alaska they use from 40- to 60-ft. gin poles in placer-mining operations and raise them off the ground without masts, writes Edward M. Keys, Jr., of Chatanika, in *Power*. Only three men are required, two at the guys and one at the hoist.



Layout for Raising Pole

When the pole is laid in place, the guys are put on, a block of wood or a cable at the butt keeping the pole from moving along. A single pulley block is fastened at the top. The pulling line runs from the hoist through the block back to a fixed point or dead-man in line with the gin pole. A pole about 15 ft. long, having a small notch cut in one end, is placed vertically under the pulling line about midway of the gin pole. When power is applied and the pulling line tightens, the gin pole is raised off the ground. After it is up some distance, the pole under the cable is released and falls, but the hoist keeps on pulling until the gin pole is erected. The illustration does not show the fixed points in their true relative positions on account of lack of space.

*34 Herriman Ave., Jamaica, N. Y.
†"Colliery Engineer," January, 1914.

Staking Out Mineral Claims in Ontario

By J. A. MacDonald*

In the Province of Ontario any one over 18 years of age who takes out a miner's license may prospect for minerals upon Crown lands or lands of which the mining rights are reserved to the Crown, and may take up work and acquire title to a specified area by making a discovery of valuable mineral, staking out and recording a claim, performing and filing proof of the prescribed development work, obtaining a survey, if in unsurveyed territory, and paying a small price per acre. Patent is given in fee simple upon the completion of these requirements.

All Crown lands, and all lands of which the minerals are reserved to the Crown, are open to prospecting and staking out if not already taken up. But there are a few exceptions. In all cases where only the mining rights are in the Crown, the prospector and miner must compensate the surface owner for all injury or damage to the surface rights.

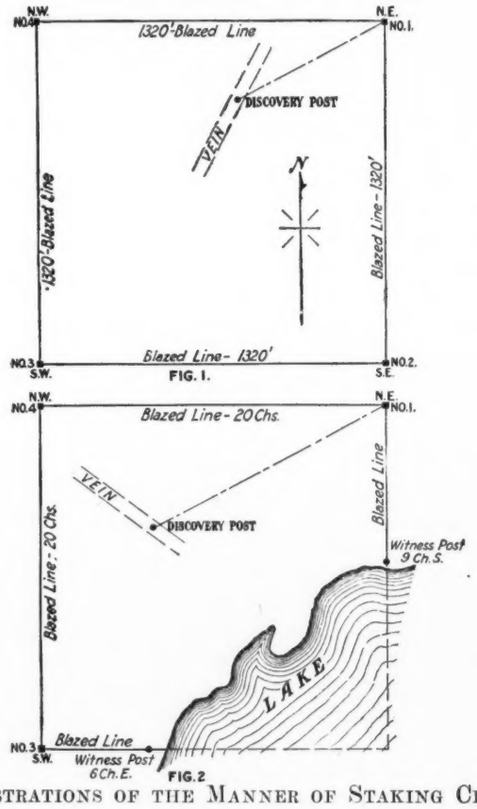
A mining claim in unsurveyed territory shall be laid out with boundary lines running north-south and east-west astronomically, and the measurements shall be horizontal. In a township surveyed into lots, or quarter-sections, or subdivisions of a section, a mining claim shall be such part of a lot, or quarter section, or subdivision of a section, and the boundaries of all mining claims shall extend downwards vertically on all sides.

Except in a special mining division, a mining claim in unsurveyed territory shall be a square of 40 acres, being 20 chains (1320 ft.) on each side.

In a special mining division, however, a mining claim in unsurveyed territory shall be a rectangle of 20 acres, having a length from north to south of 20 chains (1320 ft.) and a width from east to west of 10 chains.

A mining claim shall be staked out by: (1) Planting or erecting upon an outcropping or showing of mineral in place, at the point of discovery, a discovery post upon which shall be written or placed the name of the licensee making the discovery, the letter and number of his license and the date of his discovery, and if the discovery is made on behalf of another licensee, for and in whose name the claim is to be staked out and recorded, also the name of such other licensee and the letter and number of his license; (2) planting or erecting a post at each of the four corners of the claim, marking that at the northeast corner "No. 1," that at the southeast corner "No. 2," that at the southwest corner "No. 3," and that at the northwest corner "No. 4," so that the number shall be on the side of the post toward the post next following it in the order named; (3) writing or placing on No. 1 post all the particulars required to be upon the discovery post, and also plainly marking thereon the distance and direction therefrom of the discovery post; (4) writing or placing on No. 2, No. 3 and No. 4 post the name of the licensee making the discovery; (5) plainly blazing the trees on two sides only where there are standing trees, and cutting the underbrush along the boundary lines of the claim and plainly blazing a line from No. 1 post to the discovery post, clearly indicating the outlines of the claim, and marking a line from No. 1 post to the discovery post by planting durable pickets, not less than 5 ft. in height thereon at intervals of not more than 2 chains (132 ft.) or by erecting at such intervals monuments of earth or rock not less than 2 ft. in diameter at the base, and at least 2 ft. high, so that the lines may be distinctly seen.

Where at a corner of the claim the nature or conformation of the ground renders the planting or erecting of a post impracticable, such corner may be indicated by planting or erecting at the nearest practicable point a witness post which shall bear the same marking as that prescribed for the corner post at that corner together with the letters "W. P." and an indication of the direction and distance of the site of the true corner from the witness post.



Illustrations of the Manner of Staking Claims

Every post shall stand not less than 4 ft. above the ground, and shall be squared or faced on four sides for at least one foot from the top, and each side shall measure at least 4 in. across where squared or faced.

The diagrams, Figs. 1 and 2, illustrate the method of staking out a claim.

A prospector after a discovery of valuable mineral in place, if he desires to stake out a claim thereon, shall at once plant or erect his discovery post and proceed as quickly as is reasonably possible to complete the staking out of the claim, and if he is in fact the first licensee to make a discovery of valuable mineral in place and plant a discovery post thereon, no other licensee shall be entitled to stake out or interfere with the property while he is so completing the staking out, but if he fails to proceed with the staking out with such diligence and speed, he shall be liable to lose his rights in case another licensee makes a discovery of valuable mineral in place upon the property and completes the staking out before him.

Until a discovery post is planted or erected all licensees shall have equal rights in Ontario upon the lands open to prospecting except that where a licensee has found what he

*Box 83, Ottawa, Ont.

believes to be a vein or deposit of mineral or to be an indication thereof, he may plant or erect not more than 150 ft. apart two pickets at least 4 ft. in height to be known as prospecting pickets, each marked with the letters "P. P." and his name and license number and letter, and may dig a trench not less than 6 ft. long and 6 in. deep from each of such pickets along the line running toward the other picket, or where that is impracticable may erect a monument of rock or earth not less than 2 ft. wide at the base and at least 2 ft. high extending 6 ft. from each picket toward the other picket, and may also blaze the standing trees, if any, along the line between the pickets, and after he has so done, so long as he is diligently and continuously prospecting or following up indications on the block of land extending 25 ft. on each side of a straight line between the pickets, he shall be entitled to the exclusive right to prospect and to make a discovery thereon.

Bagley Scraper for Road Making*

A great many attempts have been made to use machinery on mountain roads, but these have generally ended in failure. The most successful machine in use probably is a Bagley scraper with a logging donkey engine. The donkey is first used to clear the right-of-way of logs, stumps, etc., and when this is done the scraper is attached to the same line. The accompanying illustrations show the manner in which this is done.

To work these scrapers successfully their limitations must be recognized. They are useless in mucking out solid rock. They handle all kinds of loose earth, gravel, and boulders containing from 1 cu.ft. to ½ cu.yd. The material must be loose. When conditions are favorable they handle from 500 to 1000 cu.yd. per 10-hr. day.

A Bagley scraper can under favorable conditions handle excavation at 7c. per cu.yd., wherever a large fill is to be made with a short haul and the material is sandy or gravel. On general road work where time is lost in moving up, splicing lines, removing large boulders, etc., the average cost for handling material is from 15 to 20c. per cu.yd. to which must be added from 3 to 5c. per cu.yd. for finishing, as the scraper leaves the work in rough shape.

On the particular work shown in the illustrations two Bagley scrapers were in use, each having a capacity of 2½ cu.yd. One donkey engine was 11x13 in. in size; the other 10¼x10½ in. The advantage of the large size is that there are no delays waiting for steam pressure. The wire cables had the following dimensions: Main line, 1⅜ in.; haulback, ⅞ in.

Daily costs may be tabulated as follows:

Foreman	$6.00 per 10-hr. day	
Engineer	3.50	
Fireman	2.75	
Hook tender	4.50	
Pump man	3.00	
Two rigging men at $3	6.00	
		$25.75
One team hauling fuel, or two men cutting fuel on right-of-way		6.00
Fuel		10.00
Use of donkey, including depreciation of lines, etc.		10.00
Finishing gang—		
Two teams and teamsters at $6		12.00
Four laborers at $2.50		10.00
		$73.75

Assuming 400 cu.yd. for an average day's work the cost was 18½c. per cu.yd.

The scraper is only a money maker in good digging. Its use requires a competent foreman and a first-class crew to handle the lines; a green outfit could not earn its board. With plenty of fuel and water, with a short haul for the material not exceeding 400 ft., the scraper should average at least 400 cu.yd. per day.

The steam shovel is not adapted to mountain work, since it cannot pull itself around as a donkey engine can and the handling of cars is both difficult and dangerous. If it is impossible to avoid bad slides or swamps, these can be handled with a scraper at the minimum of expense. The donkey-engine boiler can also be equipped with an oil burner to cut down haulage still further.

In light earth and gravel cuts a 2½-cu.yd. scraper will push another ½ cu.yd. of material ahead with a 200-ft. haul; it can easily move 1000 cu.yd. in 10 hr. It may not be amiss to add that the scrapers do efficient work on channel changes and in loading gravel into bunkers from river beds. In channel-change work the hitch should be placed so that the scraper is pulled upstream.

BAGLEY SCRAPER ON MOUNTAIN ROAD CONSTRUCTION IN WASHINGTON

*Taken from an article in "Engineering News," by F. W. Harris, recently locating engineer of the Washington State Highway Commission.

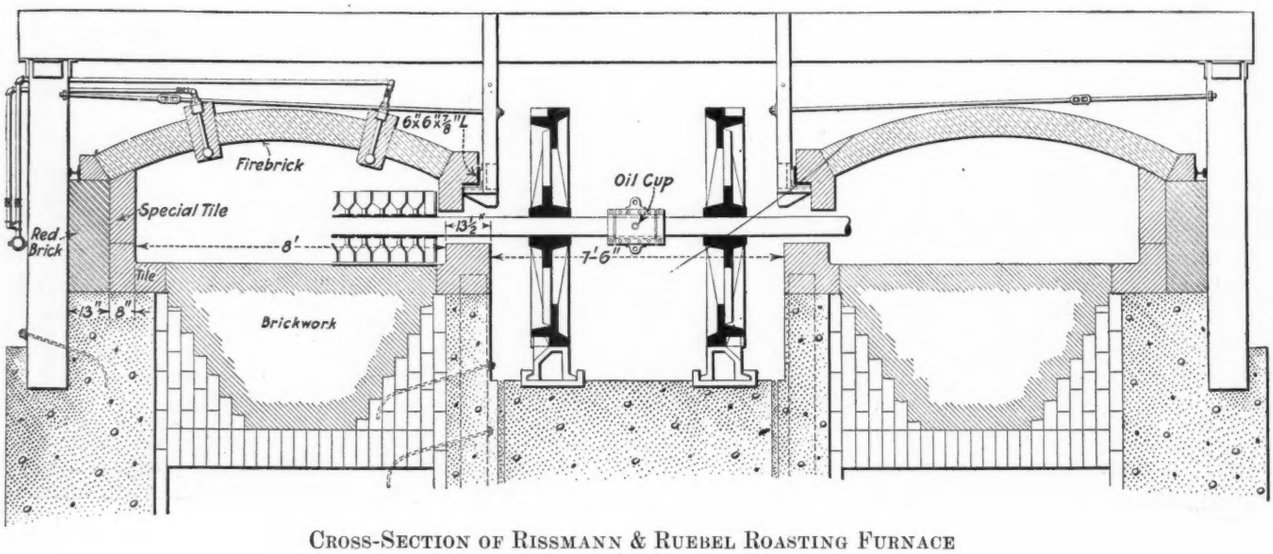
Details of Milling and Smelting

The Rissmann & Ruebel Roasting Furnace

The Rissmann & Ruebel roasting furnace, which is in use at the works of the National Zinc Co., at Bartlesville, Okla., was designed for avoiding the extremely high arch necessary in the Zellweger furnace, and consequently the excessive gas consumption of the latter.

The Rissmann & Reubel furnace consists of two separate parallel hearths, the stirring device being carried on a carriage running on a track between the two sections. The arch of each section is supported on the outside by the wall of the furnace, while on the inner side it is suspended from cross I-beams as shown in the accompanying engraving, which gives a correct idea of the construction of the furnace, except the carriage carrying the rabble.

The rabble is of the ordinary Zellweger type, except



CROSS-SECTION OF RISSMANN & RUEBEL ROASTING FURNACE

that the shaft is carried on a carriage running on a smooth track. The carriage consists of a framework of I-beams carried by four standard railway carwheels. The rabble shaft turns in two bearings on this carriage and is revolved by being geared to the axle of one of the trucks. The rabble shaft extends into the furnace through a slot which is closed by swinging cast-iron doors, opened and closed by a device on the rabble carriage.

The furnace is 150 ft. long. Each section has a hearth width of 8 ft. in the clear. The aims of the designers were partly accomplished, the gas consumption per ton of ore roasting being less than in the standard type of Zellweger furnace. The weak point about the Rissmann & Ruebel is that no satisfactory method of closing the slot, through which the rabble arm extends into the kiln, has been found. The doors in use for closing this slot permit too much cold air to enter the furnace and allow fumes and flames to escape at some places.

The Manufacture of Sponge Iron as a Precipitant for Copper*

Sponge iron was first used as a precipitant for copper in England in 1837, although Gossage, in 1859, was the first to use it in connection with the wet extraction of copper from ores. It was made by heating a mixture of finely crushed iron ore and coal in a reverberating furnace, with a reducing flame.

Since then a great deal of sponge iron has been produced by iron manufacturers, and a number of furnaces have been invented for its production, all of which are described in books on the metallurgy of iron and steel. It is now produced commercially at Hoganas, Sweden, by heating a mixture of fine magnetic iron concentrates and coal in pots or retorts by means of producer gas.

According to Sir I. Lowthian Bell, oxide of iron is easily reduced by solid carbon, but carbon-monoxide gas is greatly preferred as a reducing agent. The reduction of Fe_2O_3 begins at 420° F. The reduction of FeO begins at 1300° F. and is complete at 1475° F.

Sponge iron readily combines with oxygen when exposed to the air at a red heat. It is also capable, at certain temperatures, of splitting up the carbon dioxide formed by its own reduction.

The necessary reaction for the reduction of iron oxide by carbon monoxide seems to be

$$Fe_2O_3 + 9\,CO = 2\,Fe + 3\,CO_2 + 6\,CO$$

or, that there is as much oxygen in the CO escaping as in the CO_2 formed. This reaction is not so simple as it appears, however, for carbon monoxide gas is split into

*Excerpts from a paper by Stuart Croasdale, on "Experimental Leaching at Ajo" read at the Salt Lake meeting of the A. I. M. E.

carbon dioxide and carbon in the presence of iron oxide or metallic iron, thus:

$$2\ CO = CO_2 + C$$

Hydrogen greatly assists in the reduction of iron oxide.

Dr. Frankfurter, of the University of Minnesota, found that finely pulverized iron ore begins to reduce at about 300° F. in an atmosphere of hydrocarbon gas and is completely reduced below 1000° F. S. H. Stupakoff, in a paper read before the Engineering Society of Western Pennsylvania, states that carbon monoxide begins to reduce precipitated iron oxide at 285° F., roasted carbonate at 390° F., and is active on all ores at 750° F. It is most active at 1000°F. Solid carbon begins to reduce iron oxide at 800° F. The reverse action, of CO_2 being reduced to CO by metallic iron, begins at 800° to 1100° F., depending upon mass action, and is most active at 1475° F. A mixture of 3 CO_2 and 2 CO is oxidizing at 1000° F., and a mixture of 1 CO_2 and 2 CO is oxidizing anywhere above 1500° Fahrenheit.

My plan for the production of this precipitant was to manufacture sulphuric acid at the leaching plant, from the low-grade Bisbee pyrite, and then reduce the iron oxide in the calcines to sponge iron for precipitating the copper. The Bisbee pyrite contains about 38% iron and 1.5 to 2% copper. The copper would pay for the mining.

The calcines from this pyrite would be in ideal condition for the production of sponge iron. They would contain a finely divided, porous, artificial oxide of iron which could easily be reduced at low temperatures. The product obtained from the reduction of these calcines would contain 60 to 65% metallic iron in a finely divided, porous condition that would present the greatest possible surface for the rapid precipitation of copper and the copper contained in the original pyrite would all be recovered.

Laboratory experiments were made by mixing iron ore with 30 to 35% coal, both crushed to 16 mesh, and heating in a closed clay crucible in an assay muffle for 1 hr. at a temperature of 1600 to 1800° F. From 75 to 77% of the iron in the ore was reduced to metallic iron.

These experiments were repeated by mixing calcines with 25 to 30% coal and heating in the same manner; 98% of the available iron was metallized. Calcines were then placed in an iron tube and heated to a low red heat in an atmosphere of hydrocarbon gas for 1 hr. Over 90% of the available iron was metallized.

This experiment was repeated and the tube was heated to incipient redness for 90 min.; 93% of the available iron was metallized. The gas used for heating the tube in this experiment was the impoverished gas coming from the reduction of the calcines. The available iron in these experiments was the iron existing as oxide and not that existing as sulphide. These experiments were again repeated on calcines from Bisbee pyrite crushed to ½-in. mesh instead of 16 mesh. At the end of 1 hr., 76.6% of the available iron was metallized, and at the end of 2 hr., 88.3% was metallized.

The idea of using calcines as a source of iron is new, so far as I know, and was first proposed by me during the course of these experiments in the summer of 1912. The advantages of using this material are at once apparent from every viewpoint.

My efforts, therefore, were not to determine if sponge iron can be produced commercially, but to devise a furnace that will receive the calcines hot from the roasting furnaces, reduce them continuously and deliver the metallized product or sponge iron to the precipitating department of the leaching plant. The problem is simply one of mechanical construction with no impossible or prohibitive features. The production of sponge iron is surprisingly easy, when the conditions are right.

After trying several small furnaces of different designs, I erected a Wedge double-function roasting furnace of special design to meet my conditions. This furnace was 9 ft. 9 in. in diameter, had six roasting hearths, one drying hearth and one cooling hearth. The three upper hearths were of the ordinary type for coasting sulphide ore. The three lower were muffle hearths heated with oil from outside fireboxes. The two sets of hearths were sealed from each other by automatic cast-iron valves. The entire furnace was sheathed with sheet iron except the top and bottom. Luting rings were placed around the center shaft, and every effort was made to make the furnace as air tight as possible. Each hearth was connected with the flue so the gases could be controlled as desired. A screw feeder was attached to the side of the furnace to deliver pulverized coal on the upper muffle hearth.

I expected to be able to roast Bisbee pyrite on the three upper hearths and deliver the red-hot calcines on the top muffle through the automatic valves, where they would be mixed with powdered coal from the feeder. In this way, no heat would be lost and reduction would begin at once. I soon found that I had made a serious mistake in trying to put two furnaces into one, for I had neither a roasting nor a metallizing furnace. With all six hearths for either purpose, I would have obtained better results.

The spaces for the passage of hot gases under the muffles were too small. In order to maintain the temperature that was desired on top of the muffle, the heat directly opposite the fireboxes was high enough to soften the clay tiles and cause them to warp. This allowed the calcines, already reduced to ferrous oxide, to drop into the joints and form a fusible slag which soon made a hole through the muffle and admitted air and products of combustion just where I wanted a reducing atmosphere.

My greatest trouble probably came from air leakage through the bottom or cooling hearth and around the central shaft. The bottom hearth was made of brick arched in the usual manner. It was plastered on the under side with cement, but with the constant contraction and expansion of the furnace, it was impossible to make the air tight. I would frequently get metallization well started on the middle muffle hearth, and the iron would oxidize again before discharging. The luting rings around the central shaft, which were supposed to seal by dipping into the ore on the hearth, were not satisfactory for this purpose.

I endeavored to overcome these difficulties by producing a gas pressure inside the furnace from the combustion of the coal. In this I was partly successful, and, for short periods of time, until something broke or temperatures fell, I got encouraging results.

The highest temperatures I was able to obtain on the muffles were as follows:

	Deg. F.
Top muffle	1000
Second muffle	1320
Third muffle	1460
Cooling hearth	1040

but these were maintained only a short time before a muffle gave way.

When reducing with coal, I should have had higher temperatures, or at least 1400°, on all the muffles. The soft coal used I thought had a tendency to deposit soot on the calcines at low temperatures, which retarded the reducing action. I tried lignite coal, but with so many other adverse conditions to contend with, I could not notice any difference. I also tried powdered coke, but at that time other conditions were unfavorable, and the test was not completed.

I was anxious to use producer gas, but had no opportunity to do so. My own laboratory experiments and those of all other investigators have proved that iron oxide can be reduced much more easily with gas than with solid carbon, and producer gas made from lignite or oil would contain the most active reducing agents known for this purpose.

I regret that my work in this direction was stopped before it was carried to a conclusion, but enough was learned to satisfy myself that it will be entirely feasible to metallize calcines for copper precipitation at a cost of not over $5 per ton of metallic iron.

I believe a muffle type of furnace can be made practicable for metallizing calcines continuously, but it must be made gas tight. The top and sides should be sheathed with iron and the calcines fed through a double bell as on an iron blast furnace or through a screw feed that would always be kept full. The bottom of the furnace should be made of cast iron, or preferably, water-jacketed segments. The central shaft should be water sealed top and bottom.

Other material than the 3-in. thick clay tiles used in the Wedge furnace could no doubt be found for the floors of the muffles. It should be of some basic material. If producer gas is used for reduction, it might be possible to make these floors of cast-iron sections, because the temperature of reduction is much lower with gas than with solid carbon.

Producer gas should be used for reduction and the impoverished gas used for heating the furnace. The Mond Nickel Co. has been reducing nickel oxide by means of carbon monoxide for years in a similar type of furnace, without accident or difficulty of manipulation. Subsequent experiments lead me to believe that a shaft furnace can be developed that will also do the work with much less complicated operation.

In any case the metallized product must be cooled in air-tight hoppers that will seal the furnace, or discharge from the furnace directly into water. The fine iron oxidizes immediately when exposed to the air at a red heat, but if cooled in a reducing atmosphere or in absence of air and kept dry, it will remain unaltered for months. If it is discharged from the furnace into water, it must be kept under water until used. It is difficult to take it from the water and dry it without some oxidation but it will not oxidize under water within any reasonable time.

Method of Cleaning Bags

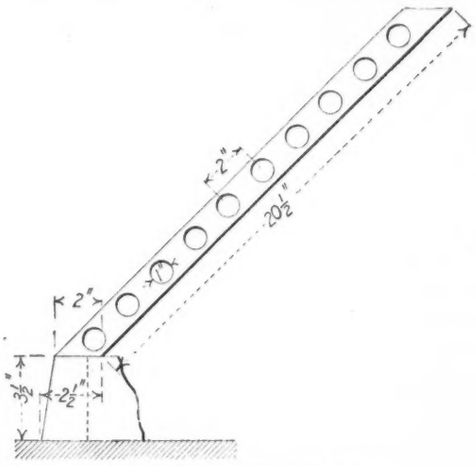
A new method of dislodging dust from baghouse bags has been patented by Willard E. Playter, of Collinsville, Ill. (U. S. pat. 1,118,044). In his construction a flexible tube attached to an air reservoir hangs down in each bag from the thimble by which it is suspended. When it is desired to clean the bags, air is turned on in these tubes, which causes their ends to thresh about in the bags, effectually dislodging all dust.

This air, carrying the dust, is allowed to flow out through large settling chambers in which the dust is deposited. The current of air through these chambers must, of course, be slow.

U. S. pat. 1,118,045 has also been granted Mr. Playter covering electric regulation of the valves controlling the flow of the gas to be filtered and the gas or air used in cleaning.

A Handy Tray for Annealing Cups

A simply made and convenient tray for holding annealing cups used in the parting of silver-gold buttons, may be made from an old piece of galvanized iron. Holes are punched with a 1-in. nipple sharpened at one end. Ends of the piece of galvanized iron may be turned



ANNEALING CUP TRAY

down to make a rest, or the plain strip can be nailed to two pieces of wood, which will serve the same purpose. If it is required to use a double row, or more, of cups, the sheet of iron is widened correspondingly and the additional holes punched.

Stamp Milling at the Consolidated Gold Fields of South Africa

The stamp mills of the Consolidated Gold Fields of South Africa, Ltd. put through a total of 3,218,310 tons during the year ended June 30, 1914. The accompanying table shows the number of stamps and tube mills working in each of the plants, and the work accomplished by then.

MILLS OF THE CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA

	Stamps Running	Tube Mills Running	Tons Milled	Tons per Stamp per Day	No Days Operating
Simmer & Jack Proprietary	320	7	760,800	6.902	344.472
Robinson Deep	118	9	580,370	15.465	318.037
Knights Deep	400	11	1,113,300	8.635	322.305
Simmer Deep	180	9	644,300	13.683	261.565
Jupiter	120	6	61,550	13.985	36.677
Sub Nigel	25	1	57,990	6.672	347.684
	1163	43	3,218,310	9.554	.....

On the basis of tube-mill days, it appears that one tube mill is required per 275 tons of daily stamp capacity.

The Cost of Doing Things

Cost of Conveyors at the Arizona Copper Co.'s New Smeltery

The following figures relative to the cost of conveyors at the Arizona Copper Co.'s new smelting plant, Clifton, Ariz., were taken from *Bull.* 91 of A. I. M. E., "Unit Construction Costs from the New Smelter of the Arizona Copper Co." by E. Horton Jones. The following table gives the cost per ton of capacity of the conveyors. These costs do not include any steel supporting structure for the conveyors. Capacities are taken from the designer's drawings:

CONVEYORS—COST PER TON OF CAPACITY

Conveyors	Capacity, Tons per Hour	Total Cost Amount	Total Cost per Ton
No. 1	100	$ 3,258	$32.58
No. 2	150	2,853	19.02
Nos. 7-1, 7-2	250	6,938	27.75
Nos. 8-1, 8-2, 8-3	450	9,929	22.07
Nos 9-1, 9-2, 9-3, 10-1, 10-2	500	11,668	23.33
No. 12	100	969	9.69
No. 13-1, 13-2	200	3,948	19.74
No. 15	100	2,674	26.74
Nos. 3, 4, 5, 6, 11, 14	700	13,716	19.59

The total length of conveyors 3, 4, 5, 6, 11 and 14 from center of head pulleys to center of tail pulleys is 1284.9 ft. and their total cost including steel structure was $44,290 or $34.47 per lin.ft. All the costs that follow cover the entire labor and material connected with the installation of the conveyors. They do not include the steel frame to which idlers are attached, but do cover the cost of installation of traveling feeder with the necessary ties, rails, wire and motor. All conveyors were furnished by the Robins Conveying Belt Company.

Conveyor No. 1 is a 30-in. belt, making a 97-ft. conveyor with a 3-ft. rise, operating at a speed of 150 ft. per min., capable of handling 100 tons an hour. It is supplied with 12-in. material from the bins above it through a speeder feeder (see page 330). The total cost of this conveyor was $3258 made up of $311 for labor and $2947 for material. The total cost per linear foot was $33.49. The material account is segregated as follows:

	Cost	Freight
202 ft. 30-in. belt	$686.80	$16.45
Feeder belt	56.75	.....
Conveying idlers, etc	1,497.12	185.09
Cent. switch	34.00	2.20
Broken pulley	44.00	.....
Miscellaneous material	307.73	.....
One 5-hp. motor	87.05	.....
Totals	$2,713.45	$233.74

Conveyor No. 2 has a 20-in. belt, making a conveyor 117 ft. long, with a 3-ft. rise, operating at a speed of 200 ft. per minute with a capacity of 150 tons taking 3/8-in. concentrates through a speeder feeder. The labor cost on this conveyor was $355 and materials, $2498; total, $2853 or $24.33 per lin.ft.

Conveyor 7-1 has a 20-in. belt, 180 ft. 3 in. from center line to center line of head and tail pulleys with an 8-ft. 9-in. rise, operated at a speed of 300 ft. per min., with a capacity of 150 tons per hour. It takes 3/8-in. material which it unloads through a 20-in. automatic tripper. It brings the fines from conveyor 5 to the bedding conveyors. Conveyor 7-2 has a 20-in. belt, 200 ft. long from center line to center line of head and tail pulleys, with a 9-ft. 2-in. rise, operating at a speed of 400 ft. per min. and capable of handling 100 tons per hr. It takes 2½-in. material from conveyor 6 which it unloads through an automatic tripper. The original installation here called for a bedding tripper at $950, which was superseded by an automatic one. Both charges are in this account. For a proper unit cost this charge should be deducted. The total cost of these two conveyors was $6938, of which $6374 was for material and $564 for labor. The total length is 380 ft. and the cost equals $18.24 per ft. The principal materials were: Belts, $1434; freight on belts, $102; total, $1536; conveyor material, $1451; two automatic trippers, $3998, which includes $369 for freight. Other material consisted of motors, lumber, drive belts, painting material, etc.

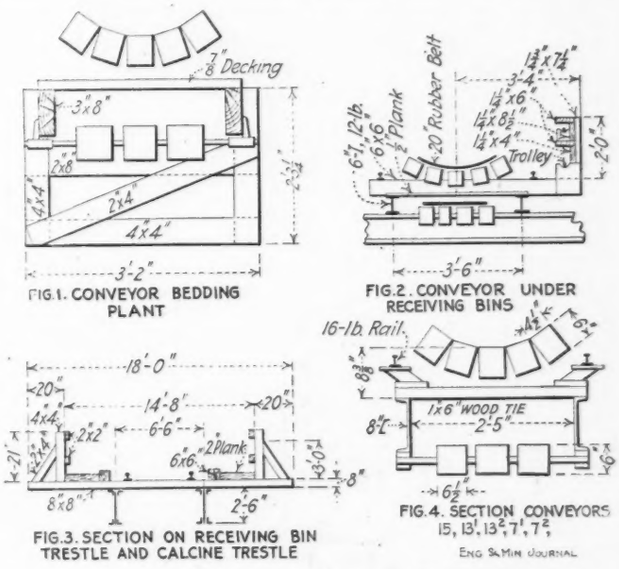


FIG.1. CONVEYOR BEDDING PLANT

FIG.2. CONVEYOR UNDER RECEIVING BINS

FIG.3. SECTION ON RECEIVING BIN TRESTLE AND CALCINE TRESTLE

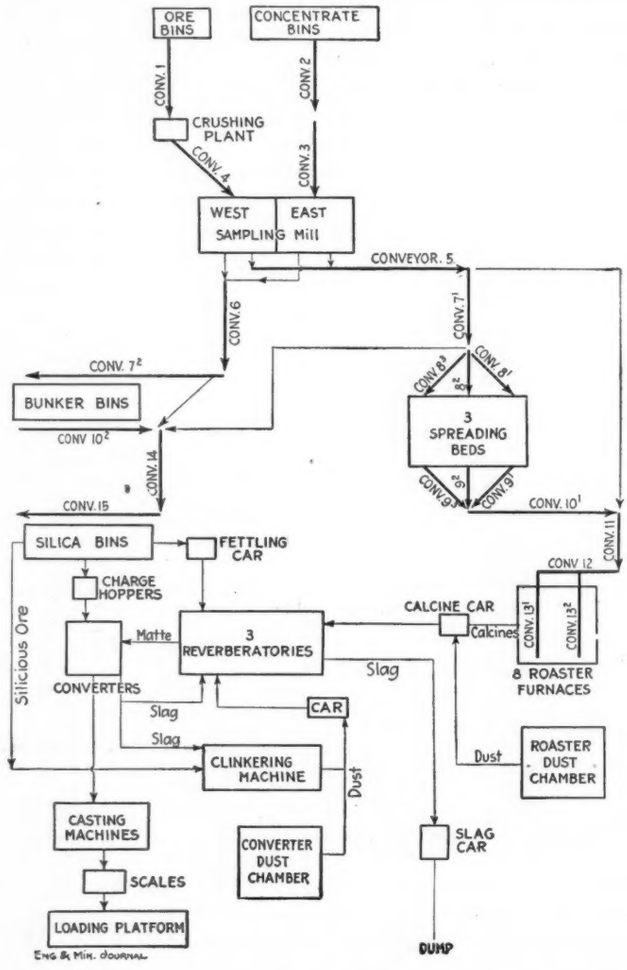
FIG.4. SECTION CONVEYORS 15, 13', 13', 7', 7'

ENG & MIN JOURNAL

CONVEYOR DETAILS, ARIZONA COPPER CO.

Conveyors 8-1, 8-2 and 8-3 are practically identical, running out over the three beds. The exception is that 8-3 has a 6-ft. in place of a 3-ft. rise at the start and is 5 ft. longer. In general, the three belts are 20 in. wide, 186 ft. 9 in. long, from center line to center line of head and tail pulleys, with a 3-ft. rise, operating at a speed of 400 ft. per min., with a capacity of 150 tons per hr., taking 3/8-in. material and distributing it through a bedding tripper onto the beds below. The total length of these conveyors is 562 ft. and the cost, $9929, of which $1211 was for labor and $8718 for material. The cost was $17.67 per lin.ft. Details of material costs follow: Belts, $2277; conveyor material, $1793; three ore-bedding trippers, $2850; freight on trippers and conveyor material, $570; lumber for walkways and decking, $237; three 15-hp. motors, $570; centrifugal switch, $109; drive belts, $72; electrical supplies, $146; painting material, $31 and miscellaneous, $63.

Conveyors 9-1, 9-2, 9-3, 10-1 and 10-2 are on wooden supports, the material for which and the cost of walkways are included. Conveyors 9-1, 9-2, and 9-3 are identical. They take the material from the beds to 10-1. They are 20-in. wide belts, 198 ft. 4 in. from center line to center line of head and tail pulleys, operate at a speed of 300 ft. per min. and have a capacity of 100 tons per hr. Conveyor 10-1 takes the feed from these conveyors to conveyor 11. It is 145 ft. 3 in. from center line to center line of head and tail pulleys, perfectly flat, operates at a speed of 300 ft. per min, and has a capacity of 100 tons per hr. Conveyor 10-2 takes material from the bunker-bin gates to conveyor 14. It has a 20-in. belt, 165 ft. from center



Conveyor Layout, Arizona Copper Co., Clifton, Ariz.

line to center line of head and tail pulleys, is flat, operates at a speed of 300 ft. per min., and has a capacity of 100 tons per hr. The total cost of these five conveyors was $11,668 and their length, 905.5 ft. Cost per ft., $12.88. Of the total cost, $1912 was for labor and $9756 for material. The cost of some of the materials follows: Belt, $3529; conveyor material, $2178; feeder conveyor for 10-2, $925; freight on conveyor material and feeder, $586; lumber for walkways, decking and framework, $755; five 5-hp. motors, $435; electrical supplies, $243.

Conveyor No. 12 takes the material from conveyor No. 11 and delivers it to 13-1 and 13-2. It is a 20-in. belt, 51 ft. 3 in. from center line to center line of head and tail pulleys, has an 8-ft. rise, operates at a speed of 300 ft. per min. and has a capacity of 100 tons per hr. The total cost was $969 or $18.93 per ft. Of the total cost $164 was for labor. The principal materials were: Belt, $223; conveyor material, $416; 5-hp. motor, $87 and $31 for lumber.

Conveyors 13-1 and 13-2 are identical. Both are 20-in. belts running flat, 109 ft. from center line to center line of head and tail pulleys, operate at a speed of 300 ft. per min., and have a capacity of 100 tons per hr. The total cost of the two was $3948 or $18.17 per ft. This cost was composed of $476 for labor and $3472 for materials. The principal items of material cost were: Belt, $896; conveyor material, including $236 freight, $2150; two 5-hp. motors, $174, and lumber, $123. Other charges for material were for drive belt, switches, spouts and miscellaneous supplies.

Conveyor No. 15 is a 20-in. belt making a conveyor 165 ft. long running flat, operating at a speed of 300 ft. per min. and capable of handling 100 tons per hr. The total cost was $2674 or $16.21 per ft. Of this cost, $423 was for labor. Of the material cost, $664 was for belt and $1231 for conveyor material and $138 for a 7½-hp. motor. The following table gives data on conveyors 3, 4, 5, 6, 11 and 14:

Conveyor No.	Width of Belt in Inches	Length of Conveyor in Feet	Rise in Feet	Speed in Feet per Minute	Capacity in Tons per Hour
3	20	182.5	46	250	150
4	20	220.7	64	250	100
5	20	127	26.3	250	150
6	20	113.6	25.5	250	100
11	20	369.7	87	300	100
14	20	271.4	71	300	100
		1284.9			

The total cost of these conveyors was $13,716 or $10.68 per ft. Materials made up $12,505 of the total cost, of which $5716 was for belt, $4821 for conveyor material and $1309 for one 10-, one 15- and four 20-hp. motors. These costs include the freight on materials.

Cost of Steel Headframe

By Percy E. Barbour

A Bisbee mine with a two-compartment shaft was supplied with a steel headframe 50 ft. high to the center line of the sheave, for ¾-in. hoisting rope, for $1400, erected ready for service. The frame weighed 18,340 lb. and cost $1110, f.o.b. Bisbee, equivalent to practically 6c. per lb. The erection cost $290, a little over 1½c. per lb. Total cost erected, 7⅝c. per lb. The steel company furnishing this headframe always figures the structural members for the full breaking strength of the hoisting rope, so that the frame will not fail in any event before the rope does.

Coniagas Mines, Ltd.

The Coniagas Mines, Ltd., at Cobalt, Ontario, produced 2,497,395 oz. silver in the year ended Oct. 31, 1914. Mining and concentrating cost 12.444c. per oz., as compared with 8.776c. per oz. for the previous year. Other costs, including royalty, amounted to 3.585c. per oz. as compared with 4.321c. for the previous year. Average price received for silver was 56.75c. per oz., as compared with 60.55c. for the previous year. The total ore milled was 54,522 tons for the year, or 2.93 tons per stamp per day. Profit, after adjustments, amounted to $968,387 for the year.

Tuberculosis in the Joplin District*

SYNOPSIS—Prevalence of tuberculosis and fibrosis in southwest Missouri closely related to excessive dust in sheet-ground mines. Dust caused by various practices, chiefly that of drilling dry holes. Recommendations offered for abatement of dust and elimination of other unsanitary practices. Legislation suggested.

The miners of the Joplin district, and their families are practically all native American stock. Many of them are but one or two generations removed from the Tennessee mountains and the Arkansas farming country and as they drift into mining work are most often fresh from Missouri farms. These people are intelligent, independent and industrious; as a rule they marry young and large families are frequent. Their efficiency, so far as labor in the mines is concerned, is high. Many of them prosper in mining and it is a common saying in southwest Missouri that every miner is a prospective mine operator. While the sanitary environment of their homes often leaves much to be desired, from a public-health standpoint their faults are essentially due to lack of knowledge of the effect of certain practices. It is probable that sanitary education would not only be well received in the communities in the Joplin district but would work a great deal of good.

Efforts to Combat Tuberculosis

In recent years there has been an unusual prevalence of pulmonary tuberculosis and a high death rate therefrom among the metal miners in southwest Missouri. Various efforts have been made to ascertain and abate the causes of the trouble. This movement resulted in the formation of the Jasper County Anti-Tuberculosis Society, and of various committees of mine operators. The Anti-Tuberculosis Society, besides gathering statistics, established in October, 1913, a visiting-nurse service, which has proved valuable. The mine operators have succeeded in the last two years in making many substantial improvements in working conditions underground. The state mine inspectors have also made this work one of their especial functions, although handicapped by the lack of any laws on the subject. As regards improvement of sanitary conditions in miners' homes, action by local health officials is necessary. Few if any of the miners live in company homes so that the operators have little direct control of sanitation in dwellings.

Appearance of Tuberculosis and Its Causes

It seems to be the general opinion in Jasper County that lung diseases became more prevalent after the beginning of active operations in the sheet ground, and that the flint dust occasioned by drilling and other mine operations is largely responsible for this condition. Although the connection is not definitely established and the available records are not satisfactory, nevertheless the figures both of the state board of health and of the Jasper County Anti-Tuberculosis Society demonstrate an unusual prevalence of tuberculosis in that county. Furthermore, allowing for various differences of opinion, inaccuracies, errors and exaggerations, all unavoidable, an impartial investigator cannot but conclude that when working conditions in any region are such as to expose the workers to a hard, flinty, insoluble rock dust, and when among those workers there is a high death rate from tuberculosis, there is a definite connection between the dust and the disease and the dust is largely responsible for the disease—not entirely responsible for all pulmonary disease but a prime factor in its causation.

Physical Examination of Miners

Physical examination of miners was made on several occasions in Webb City and Carterville and 93 miners presenting themselves for examination. Of these 93 men, 64 showed plain and definite evidence of pulmonary disease, 3 were suffering from nonpulmonary disease, and 26 were apparently well. Of the 64 sick men, 22 had stopped work on account of their health, the remaining 42 still working underground. Of these 64 men, 39 had the classical symptoms, nightsweats, cough, hemorrhage, loss of weight, fever, and signs of pulmonary tuberculosis. The physical signs of the other 25 men were not such as to justify a diagnosis of tuberculosis on one examination. All of these 25 had noticeable short wind, cough, and lessened ability to work; 11 showed signs of lung injury, while 14 in spite of marked symptoms presented nothing tangible on physical examination, their condition resembling silicosis, or miners' consumption, rather than tuberculosis.

Causes of Dust

There was little or no rock dust to be found in mines other than those in the sheet ground. For this reason the investigation of rock-dust conditions was confined almost entirely to sheet-ground mines. The chief causes of rock dust in these mines are the blowing of dry holes, squibbing and boulder popping. Among other causes may be mentioned shoveling, drilling without water, pillar and roof trimming, tramming and the dumping of the bucket on top.

Where the face is comparatively dry, as in most of the sheet-ground mines, the blowing out of the drill holes produces great quantities of dust. This practice is entirely unnecessary and its elimination will do much toward keeping the mine air clear of dust. The popping of boulders during the time when the men are in the mine is also entirely unnecessary and should be prohibited. The only time when there is a valid excuse for squibbing is when the drill refuses to work in a hole that is well along toward completion and the abandonment of the hole would result in a great loss of time. It seems to be the common practice, instead of trying to overcome this difficulty by lining up the machine, to withdraw the drill immediately and resort to powder to remove the obstruction. In most cases the difficulty could be overcome by a proper alignment of the drill.

Various types of drills in which water is caused to pass through the core of the drill steel have been tried with success in a few of the mines. While it might work a hardship on many of the operators if they were compelled to change their equipment from drills working without

*Condensed from an abstract of a report made by A. J. Lanza, passed assistant surgeon, U. S. Public Health Service, and Edwin Higgins, mining engineer, U. S. Bureau of Mines, entitled "Sanitary Conditions in the Zinc-Lead Mines of the Joplin, Mo., District, and Their Relation to Pulmonary Diseases among the Miners."

water, now commonly in use, to those using water, the tendency should be in securing new equipment to procure some type of water drill. It is of course possible, however, to equip any drill with a water spray directed into the drill hole and make these sprays effective in preventing dust, but such equipment is not recommended as superior to drilling machines which provide for water passing through the core of the drill.

A certain amount of dust is made in shoveling but the quantity may be either great or small depending on whether the dirt is wet or dry. A thorough wetting of the broken rock at the face by means of water hose would be effective in abating such dust. The dust produced by other operations such as tramming, pillar and roof trimming, and the dumping of the bucket on the surface need not be discussed at length. Dust from these causes will doubtless be abated as a result of the free use of water at the working faces.

A total of 39 dust samples were taken. These were secured under all conditions that commonly arise during the progress of mine work. It should be borne in mind that nearly all drill holes bored in these mines are practically horizontal. In the Joplin district, unlike metal mines in which operations are conducted on various levels, dust when produced permeates the whole mine. The greatest quantity of dust, however, is found at the working faces. The men at the face, constituting a large majority of the men underground, are subjected to a dusty atmosphere during their entire shift.

Measures in Use for Rock-Dust Abatement

About two years ago the three mine inspectors of the Joplin district began a campaign for the abatement of rock dust. Although a few of the operators adopted recommendations for spraying the working faces and wetting dry holes it was found a difficult matter to bring about a general adoption of precautionary measures. Even in cases where the operator piped water to the face, the miner himself showed little tendency to use the water thus provided. The mine inspectors have been insistent in their efforts, with the result that some of the mines are in fair condition so far as the prevalence of rock dust is concerned. During the present investigation is was found that many of the mines have either separate water lines to the face or provision for introducing water into the air lines. Many of the operators also were making efforts, through their ground bosses, to cause the miners to use water and to refrain from excessive squibbing and blowing of dry holes. However, it may be said in general that these efforts have not gone a great way toward eliminating rock dust in the mines.

Effect of Rock Dust

The influence of rock dust in the sheet-ground mines as a factor in the prevalence of tuberculosis can hardly be overestimated. While the general causes that tend to produce high incidence of tuberculosis, such as housing, alcoholism and poor working conditions, are fairly well defined and while these causes are more or less in evidence in Jasper County, the flint dust constitutes an unusual element of danger not found elsewhere, so that it would seem reasonable to attribute to it the unusual prevalence of tuberculosis in that district. Dust is nearly always injurious to the lungs to a certain degree regardless of its nature, as statistics of dusty trades will show. The properties of the rock dust in sheet-ground mines as regards hardness, sharpness and insolubility, are sufficient evidence of its ability to harm lung tissue. These minute, sharp flinty particles irritate the lung tissues, injure it, and render it susceptible to attack by the tubercle bacillus. It can hardly be believed that men constantly working in such dust can escape with uninjured lungs.

It is possible for a miner to have his lungs injured by rock dust, so as to produce a condition that is not tuberculosis, and that this occurs in the Joplin district is the opinion expressed by various physicians who treat miners there. This also would appear to be the condition of the 25 men previously referred to, who were examined and in spite of marked symptoms offered little or nothing on physical examination. Irritation by rock dust produces a fibroid or thickened condition of the lungs, leading to dyspnea (short wind), with cough, expectoration, lessened working ability, impaired general health and sometimes loss of weight. If a tuberculous infection has not accompanied this condition, undoubtedly in most cases it follows it and that before a long time. The state board of health does not recognize miners' consumption as a cause of death on death certificates. The question of the relative incidence of the two diseases is a scientific rather than a practical one. From a public-health standpoint the fact that a condition of miners' consumption may precede actual invasion by the tubercle bacillus, influences in no way the sanitary picture of the district as a whole. It helps to establish rock dust as a contributory factor in the causation, it does not influence the ultimate effect nor does it influence the application of remedial measures. Clinically, where the lungs have been injured by rock dust, the consequent tuberculosis is prone to be of the fibroid type, and the medical superintendent of the state hospital for tuberculosis states that these patients do not respond so readily to sanitarium treatment as the average run of patients and that the outlook for them is nearly always bad. This is but natural, as lungs substantially injured by mechanical means would have less chance of withstanding a tuberculous infection than otherwise.

It is not to be expected that there will be any immediate improvement in the vital statistics of the county following a reduction in the quantity of rock dust in the mines. There is far too much tuberculous infection spread throughout the district for quick results, but such good results will be apparent in time. When the mine operators of the Joplin district coöperate to devise methods of allaying rock dust, and, so far as practicable, put these methods into effect, they will free themselves from any liability to reproach that, insofar as working conditions are concerned, they are responsible for a menace to the health of their employees.

Recommendations

The following recommendations are offered as a result of the investigation:

(1) Means should be employed for the abatement of rock dust in the mines as follows: Provide a water supply for every working face, preferably by the laying of separate water lines; as rapidly as may be without too great cost, equip all miners with some type of drilling machine which provides for water passing through the core of the drill into the drill hole, although results almost as good may be obtained by equipping the present type of dry drill with a water spray; make and strictly enforce rules

against squibbing and boulder popping during the time that the shift is underground; and against the blowing of dry holes at any and all times; thoroughly wet the working faces and the broken rock every morning and again at noon if necessary; improve ventilation by the sinking of new shafts whenever practicable.

(2) Do away with common drinking cups and kegs, and water pipes which allow the miner to bring his lips in contact with the orifice.

(3) Do not employ as shovelers, men under 20 years of age.

(4) Through coöperation among the operators provide a maximum daily tonnage for shovelers so that they cannot injure their health through overwork.

(5) Provide a warm, dry and clean place in which the miners may change their clothes.

(6) Through intensive educational campaigns in the public schools and among the miners themselves, disseminate information as to the harmful effects of unsanitary practices and conditions, such as crowded living quarters, overwork, exposure, dissipation, the breathing of air polluted by powder fumes and rock dust, the use of common drinking devices, etc.

State Laws

It is believed that certain legislation would be of value in abating rock dust and other evil conditions in and about the mines. If such legislation is undertaken by the State of Missouri, it is suggested that it be made operative against the miner as well as the operator, and that penalties be provided, in the form of fine or imprisonment, such as will insure a minimum number of infractions. The following regulations are offered for consideration in this connection:

(1) That all operators of dusty mines be compelled to run a water line, in addition to the air line, to each working face, and to provide water for said line.

(2) That every miner be compelled to make use of the water so provided, for the purpose of wetting down the broken ore, the working faces, and the drill holes from which dust may be spread.

(3) That the practice of breaking boulders by means of powder or dynamite be prohibited except when the shift has left the mine.

(4) That the blowing of drill holes without first thoroughly wetting them with water be prohibited at all times.

(5) That managers or operators of mines be prohibited from maintaining common, unsanitary drinking devices.

In addition to these suggested laws, it is believed that a workman's compensation act would go far toward improving safety and sanitary conditions in the mines of the Joplin district.

Copper Production in Russia

Special Correspondence*

The copper production in Russia from Jan. 1-Sept. 1, 1914, was 47,152,986 lb. against 50,740,618 lb. for the same months in 1913, a loss of 3,587,632 lb. less or 7.7%.

	1913, Lb.	1914, Lb.
Ural	25,674,510	23,549,578
Caucasus	14,719,748	13,313,258
Siberia	8,196,971	8,283,748
Chemical factories	2,149,345	2,000,381
	50,740,618	47,152,986

*Dated Dec. 8, 1914, received Jan. 27, 1915.

The works of the Caucasus Copper Co. and the Kwarzchana works of the Siemens Copper Co. have been since Nov. 4 (old style) in the hands of the enemy. The first ones were producing 18,000 to 28,800 lb. daily, the last one was in course of construction and expected to start operation at the beginning of 1915.

Improvements at Lena Goldfields

At the recent meeting of the Lena Goldfields, Ltd., in London, the directors announced several important recommendations made by Consulting Engineer C. W. Purington to the Lenskoi board in Russia. These were: (1) That in the working of the Feodosievsky claims a considerable economy, involving a large increase of profit, is possible; (2) that the provision of change houses at shaft heads ought to lead to a great reduction in the loss of gold by stealing; (3) that by the use of improved riffles in the sluices, and of quicksilver, a great loss of gold could be obviated. Mr. Purington, from an examination of the present field and the surrounding area, is satisfied that there are such reserves of gold to be won at a profit by methods other than drift mining as will insure to the Lenskoi company a long life, but to secure much of this gold, further capital expenditure would be necessary.

Some extracts from Mr. Purington's report, regarding the technical practice, are of interest: Following representations made to the Lenskoi board, it is now planned to introduce modern gold-saving methods. Alaskan sluices, introduced during the last fiscal year for the first time, recovered from 96 to 98% of the gold as compared with a recovery of 88 to 93% by the trommel machines and other Siberian methods employed. It has therefore been decided to supplant all washing machines and Siberian sluices (*kulibinas*) by Alaskan type sluices as fast as possible. Quicksilver cannot be used until the arrival of adequate retorting appliances on the property.

Details of operating costs were not available at the time of the report but some reduction of the 1912-13 working expenses, which amounted to 29s. 7d. per cu.yd., will be shown in the account for the year 1913-14; for the month of May last, the figures show a marked reduction over those of the previous year; it is evident that at least 150,000 rubles have been saved to the company in 1913-14 by the introduction of improved methods of surface transport and gravel washing at a few places on Feodosievsky and Nizhni; overhead and construction charges were far less than in the previous year. The gravel washed in 1913-14 amounted to 873,635 cu.yd. which yielded an average of 29s. 4d. per cubic yard.

Many recommendations of an urgent nature have been made to the Lenskoi board, with a view to reducing both working and overhead costs. Mr. Purington has been assured that in so far as possible the larger perecentage of changes recommended by him will be carried out. These changes include the introduction of the "longwall and caving" system of underground mining, systematic recovery of timber, electric underground transport of gravel, improvements in hoisting, the installation of "all-the-year-round" sluicing plants of the Alaskan type for washing gravel, improved riffles, the use of quicksilver and

the closing down, so far as possible, of the unprofitable portions of the property. The company has secured as chief assistant to the general manager on the property, R. E. Smith, an American placer engineer, who is personally superintending many of the proposed changes that have been authorized.

The drilling practice on the property has undergone some improvement. As a result of temporary depletion of the force, following mobilization, all drilling was suspended during August and September, though it has since been resumed; during 1913-14, a total of 581 holes were drilled aggregating 37,877 ft., the average cost being 7.86 rubles ($4.04) per ft. The usefulness of some of the sampling was vitiated, however, by the fact that inaccurate methods and sampling instruments were in use. It is planned to place all the Keystone and other prospecting work in the hands of a competent sampling engineer.

It is expected that to a great extent drift mining will eventually be replaced by hydraulicking. On the Bolshoi Chanchik, Mr. Purington estimated that by means of hydraulic giants and mechanical elevation of the tailings the profitable ground amounts to 10,000,000 cu.yd. of an average tenor of 1s. 9d. per cu.yd. with a total gold content of 8,430,000 rubles; this ground would yield a profit on working of £520,000 in 10 years by hydraulicking, as against £34,000 per annum for four years on the drifting basis. In the Bodaibinsky ground, on the basis of hydraulicking a certain area instead of working by drifting, the following calculation was made: On 1,270,000 cu.yd. of a tenor of 21s. 9½d. per cu.yd., the result by drifting would be a loss in working of £307,000; by the adoption of the hydraulic method and treating 12,700,000 cu.yd. of a tenor of 2s. 2d. per cu.yd., the operations would show a profit of £852,000. Further, as regards hydraulicking possibilities of the Bodaibo Valley generally, Mr. Purington came to the conclusion that practically 75% of the creek-bed gravels of the lower 33 versts of the company's holdings on the Bodaibo River below Bolshoi Chanchik, down to the Agripinsky claim, as well as the lower part of the Nakatami, are so far as physical conditions are concerned capable of being worked by the above method. At this time no specific statements can be made, except that all conditions are favorable and that four blocks of ground afford a total on the hydraulic basis of approximately 56,000,000 cu.yd., having an estimated recoverable value of £5,113,000 and a probable profit on working, of £2,759,500. More definite estimates cannot be made until supplementary systematic sampling has been carried out. There are, besides, extensive areas of bench gravels bordering the Bodaibo Valley which can be worked hydraulically without elevating the tailings, and which it is planned to prospect extensively during the next few years. It is stated that the conditions of water supply are superior to the well known placer districts of Alaska and the Klondike. Investigations are in progress with a view to the establishment of a central hydro-electric plant on the Mamukan River. An investigation of a quartz vein in Bodaibo Valley is also being made and it is recommended that a competent assayer be sent to the property so that the vein can be systematically sampled and assayed. The vein has been traced for about 20 miles and has been located by the Lenskoi company. On Sept. 30, 1914, there were 7636 men on the mines' payroll, though a considerable reduction was made during 1913-14 in the man power per cubic yard handled in certain operations. The gradual amelioration of technical methods is expected to bring about a corresponding reduction in working costs.

Searles Lake Patent Protest

The applications of the California Trona Co. for mineral patents for certain potash lands of Searles Lake, California, have been protested by Victor Barndt, of Tonopah, in papers filed with the General Land Office at Washington, D. C., on Feb. 1, 1915. The bases of the protest are unusual by reason of the peculiar conditions resulting from the extended search for potash, and the "locating" campaigns at Searles Lake. Mr. Barndt opposes the granting of the patent applications on the following grounds: (1) Attempt to establish monopoly; (2) failure of locators to make discovery; (3) that locations were not made in good faith.

At present, three applications are filed in the U. S. Land Office at Independence, Inyo County, Calif., by the California Trona Co. for patents to certain trona placer claims at Searles Lake. Each of these three applications, Mr. Barndt regards as a test case intended to secure to the California Trona Co. title to substantially all of the known potash deposit at Searles Lake. He states:

> The first application is for six association placer claims of 160 acres each, located during July, 1910, by C. E. Dolbear and seven others. Against this application an adverse has been filed by contesting claimants and the matter is now in the California courts.
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> The second application is for one association placer claim of 160 acres located in July, 1910, by C. E. Dolbear and seven associates. No adverse claim covers any portion of this ground. The claims located by C. E. Dolbear and the same seven associates during July, 1910, comprise 257 association claims of 160 acres each, covering a total of more than 41,000 acres. All were conveyed to the California Trona Co. immediately after location.
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> The third application is for four placer claims of 20 acres each, located in May or June, 1912, by S. W. Austin, being a portion of 1392, more or less, 20-acre claims located by Austin during May and June, 1912, and by him conveyed to the California Trona Co. on Nov. 12, 1912. No adverse claim covers any portion of this particular 80 acres.
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> The Austin locations are on lands embraced within the Dolbear locations, and include the entire known commercial deposit of potash, borax and soda at Searles Lake, excepting the small percentage embraced in lands patented to the San Bernardino Borax Mining Co.

Mr. Barndt, in his protest against the proposed monopoly of Searles Lake, suggests that this could be obviated by the establishment of a Federal leasing system, such as now before Congress, and that the California Trona Co. should be given the first choice of such leases as a recognition of its important and useful work in developing this deposit. Mr. Barndt is president of the Railroad Valley Co., which spent over $100,000 in prospecting for potash in Railroad Valley, Nevada, and other places in the West. He says that a large amount of money and effort has been expended by various private parties and by the Federal Government in the search for commercial sources of potash; Searles Lake is the only known commercial deposit of potash in the United States and is likely to remain so. To allow one party to obtain patent upon substantially all of this deposit would, he thinks, establish a dangerous monopoly in a necessary commodity. In protesting the patent on this ground, he says:

> If the present applications are allowed and patent is granted to the lands now applied for, the California Trona

Co., by making additional separate applications for patent, could ultimately control substantially all of the potash deposit at Searles Lake and thereby control and monopolize the future potash industry of the United States.

I respectfully submit that the mineral laws and the practice of the General Land Office, as well as the rules and customs of the mining districts of the United States, do not contemplate and never have contemplated that any one person could acquire by location an unlimited area of the public domain, especially if this area include substantially all of the known national resources in a necessary mineral. The attempt of the California Trona Co. to accomplish this end is without precedent in the mining history of the United States. I submit that it is entirely without justification and that in justice to other citizens and to the welfare of the country, it should not be allowed. The laws of the United States provide that the public mineral lands shall be open to location and entry by all of the citizens of the United States. The attempted location by one party of large areas of mineral lands containing the entire known national resources of a valuable mineral would, if permitted, destroy the rights of other citizens to locate portions of these lands.

Anent "failure to make discovery," preceding location of the claims, Mr. Barndt says:

With the possible exception of a few bordering claims not of great value, no discovery of potash, borax or soda was made by C. E. Dolbear and his seven associates upon any of the 257 association claims when the locations were made in July, 1910, or prior to Aug. 11, 1910, when the locations were transferred to the California Trona Co. Between Aug. 11, 1910, and the Federal withdrawal of these lands on Feb. 21, 1913, discovery was made upon a portion of these claims. But even the claims upon which discovery was made after transfer are invalid and void except as to 20 acres each, and no selection or segregation of 20 acres out of any of the said association claims has been indicated.

Upon the great majority (probably nearly 90%) of the Austin locations, no actual discovery of mineral other than common salt had been made at the date of the Federal withdrawal of these lands, Feb. 21, 1913. Upon the majority of these claims, no discovery has been made even at this date. A discovery after the Federal withdrawal does not validate a location. The finding of common salt or of noncommercial traces of other minerals does not constitute discovery in this case.

Regarding Dolbear's 1910 locations, the protest states:

The records indicate that Dolbear and seven associates, each of whom at that time was a stockholder of the California Trona Co., were, in making the locations in 1910, not locators in good faith as they pretended to be, but were dummy entrymen who located solely in the interest and on the behalf of the California Trona Co. I submit that these locations are therefore fraudulent and void.

Through supplementary statements of Mr. Barndt's attorneys, it is presented that in each of the three layers or series of locations with which Searles Lake is plastered, most, if not all, of the claims are void or voidable on grounds of nondiscovery or of dummy entries. It appears that the California Trona Co. has not applied for patent, under any of the 1908 Dolbear locations, but, as already noted, has filed two applications on certain 1910 Dolbear locations and a third application on 80 acres located by Austin, on which there were no adverse claims.

American Institute of Mining Engineers

The program for the annual meeting in New York shows that on Feb. 15 in the morning there will be a technical session on safety and sanitation, under the auspices of the committee, with papers as follows: Frank H. Kneeland, "Safeguarding the Use of Mining Machinery." Howard N. Eavenson, "Safety Methods and Organization of United States Coal & Coke Co." S. Le Fevre, "Housing and Sanitation at Mineville." J. Parke Channing, "Enlarging the Worth of the Worker and the Perspective of the Employer."

Throughout the meeting an exhibition of safety and sanitation will be maintained by the committee in one of the meeting rooms on the fifth floor.

In the afternoon two separate sessions will be held, one on nonmetallic minerals, at which the papers presented will be: Edward G. Norton, "The Origin of the Louisiana and East Texas Salines." W. B. Phillips, "Investigation of Sources of Potash in Texas." Thomas L. Watson and J. Sharshall Grasty, "Barite of the Appalachian States." N. B. Davis, "The Plasticity of Clay and Its Relation to Mode of Origin." Charles H. MacDowell, "German and Other Sources of Potash Supply." Joel H. Watkins, "White-Burning Clays of the Southern Appalachian States." Joseph Hyde Pratt, "Minerals Used in Manufacture of Lighting Apparatus."

The other session will be on iron and steel; the program will be given in next week's JOURNAL.

On Feb. 16 in the morning there will be held the annual business meeting. Following this there will be a technical session, at which the following papers will be presented: David Cole, "Development of the Butchart Riffle System." R. H. Richards and Boyd Dudley, Jr., "Experiments on the Flow of Sand and Water Through Spigots." Arthur B. Foote, "An Improved Form of Cam for Stamp Mills." L. W. Bahney, "Method for the Determination of Gold and Silver in Cyanide Solutions." Paul Billingsley, "The Boulder Batholith of Montana." Basil Prescott, "The Main Mineral Zone of the Santa Eulalia District, Chihuahua." Noel Cunningham, "Metallurgical Practice in Porcupine District." W. H. Corbould, "Cloncurry Copper District, Queensland." C. A. Heberlein, "Mining and Reduction of Quicksilver Ore at Oceanic Mine, Cambria, California."

In the afternoon there will be a technical session on fuels, under the auspices of the Committee on Petroleum and Gas and the Committee on Coal and Coke.

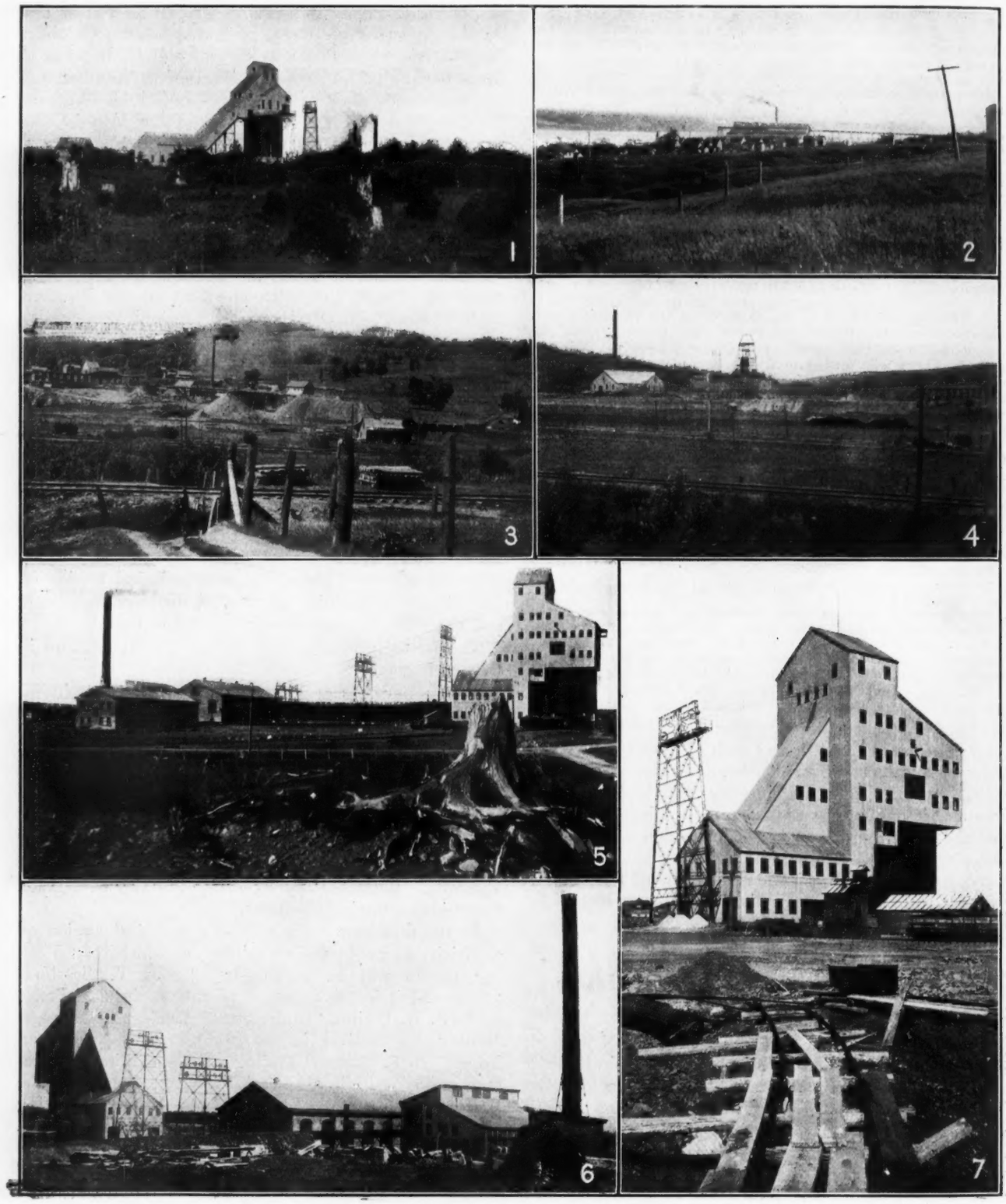
The annual dinner will be held at the Hotel Astor in the evening.

On the morning of Feb. 17 there will be a technical session on nonferrous metallurgy, at which the following papers will be presented: Manuel Eissler, "Copper Smelting in Japan." Boyd Dudley, Jr., "A Study of the Chloridizing Roast, Etc." Louis V. Bender, "Coal-Dust Fired Reverberatories at Washoe Reduction Works." David H. Browne, "Coal-Dust Fired Reverberatory Furnaces of Canadian Copper Co." F. C. Newton, "Effect of Zn_3Ag_2 upon the Desilverization of Lead." R. E. H. Pomeroy, "Reverberatory Smelting Practice of Nevada Consolidated Copper Company."

In the afternoon there will be a technical session on electricity in mines and on mining, at which the following papers will be presented: Charles V. Seastone, "Hydro-Electric Development of the Peninsular Power Co." J. W. Gwinn, "Underground Haulage by Storage-Battery Locomotives in the Bunker Hill & Sullivan Mine." B. F. Tillson, "Testing and Application of Hammer Drills." P. B. Scotland, "Mining Methods of the Arizona Copper Co., Ltd." James Humes, "Mining Methods at Park City, Utah." Courtenay De Kalb, "Some Defects of the United States Mining Law."

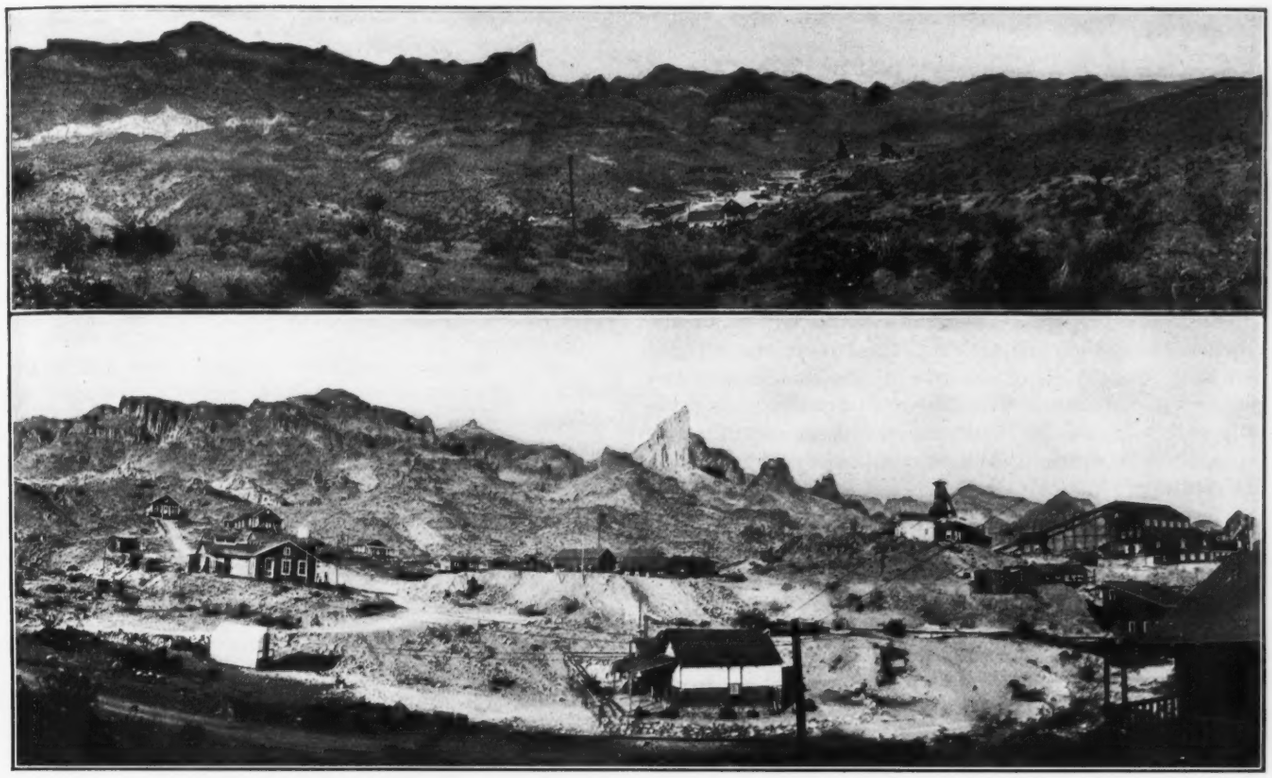
A special feature of the meeting will be reunions of graduates of a number of colleges and technical schools who may be present. Preparations have also been made for the entertainment of the ladies.

Photographs from the Field



SOME MICHIGAN COPPER PROPERTIES

1. No. 6 shaft, Mohawk copper mine, Mohawk, Mich. 2. The Ahmeek stamp mill, Hubbell, Mich. 3. Old Breitung Hematite mine. 4. New Breitung Hematite equipment. 5, 6 and 7. North Ahmeek shaft, in the Superior copper district



THE TOM REED CAMP, OATMAN, ARIZ.

The distant view gives an idea of the extremely rugged character of the country. The closer view shows the mill and buildings of the Tom Reed company

SILVER KING CONSOLIDATED, PARK CITY, UTAH

Surface plant and improvements, including shafthead, mill, dump tramway and company buildings

Editorials

The Situation in Lead

The curtailment of lead production by the Southeastern Missouri and Coeur d'Alene mines continues upon a drastic basis. Judging from the receipts of ore by the smelters the rate of production in the last quarter of 1914 was only about 55% of the rate in the first and second quarters of that year. The Missouri curtailment is probably not so large as in Idaho, but it is large enough to be no half-way measure. A reliable estimate is that the present rate of production in Missouri is about 70% of what it was last summer.

The principal lead miners of the United States are therefore in about the same position as the copper miners, although the basic causes are different. The copper miners had to curtail because they lost their principal customer. The lead miners gained new customers but wanted to produce too much anyhow, wherefore they had to be restrained. When the price for lead went down to 3.50c., New York, they did not like it and curtailed, but when later it rose to 3.90c. they became somewhat restive and meditated putting on a little more steam.

It would appear therefore that the lead market might be fairly stable around 3.70@3.80c. until some new determinative condition develops. At present the backbone of the market is the foreign demand. An increase in domestic demand is ardently desired but is slow in coming. Some persons are looking for the high price for spelter to be reflected in an increased use of lead, but that hardly seems likely, at least not to any large extent. The zinc-white business of the United States is quite distinct from the spelter business and the manufacturers of zinc white are hardly likely to give away hard-earned ground to the white-lead manufacturers. Nor is there much opportunity for lead-covered metal to displace galvanized. Our zinc-sheet business is relatively too small to allow any leeway.

The thing that stands out most clearly is that our present capacity for producing lead is very large. If the output of the United States increased upward of 100,000 tons in 1914 after a curtailment in the third quarter and a further curtailment in the fourth, bringing us down to a basis of 55 to 70% of the maximum, what would have been the production if there had been no curtailment?

Modernizing the Lena Placers

One of the world's great gold placers is in the Irkutsk Government of Siberia. Its operations are now being modernized under the direction of an American engineer, C. W. Purington. The production by the Lenskoi company since its formation to date has been approximately $100,000,000; besides this, the gold production on the Industrial claims, before their purchase by the Lenskoi company in 1910, was more than $100,000,000, making the production from these properties about $200,000,000 up to date. For several years, however, Lena Goldfields' shares have not been so popular; the great labor strike in 1912, combined with the exhaustion of some of its richest drifting gravel, caused a serious examination into the affairs and operations of the Russian company.

Old operations, especially in an isolated country, are apt like old people to get into ruts from which it is difficult to stir them until financial considerations compel a change. The high gold content of the Lenskoi gravel was not conducive to great efficiency, as a good profit could be obtained by almost any method. With the exhaustion of much of its richest ground, however, the company has been inspired to look into the question of a more efficient handling of the gravel. Conditions are now improved, and the directors in London have put themselves on record as approving the recommendation of their engineer for the establishment of modern methods.

Among the technical improvements recommended by Mr. Purington are the introduction of the "longwall and caving" system of underground mining, systematic recovery of timber, electric underground transport of gravel, improvements in hoisting, the installation of Alaskan sluicing plants, improved riffles, the use of quicksilver, and better methods of surface transport and washing. Another urgent recommendation made to the Lenskoi board was for the establishment of change houses at shaft heads, whereby a great reduction in the loss of gold by theft is anticipated.

From a preliminary examination of the present field and the surrounding area, Mr. Purington is satisfied that the Lenskoi company would be assured a long life by installing other forms of mining; hydraulicking, assisted by mechanical elevation of the tailings, and straight hydraulicking will permit the treatment of much gravel too low in grade for drift mining and the water supply is reported to compare favorably with that of "well known placer-mining districts of Alaska and the Klondike." However, to secure this gold by new methods will require an important capital expenditure and the directors wisely suggest that for the moment this development be deferred and operating attention be directed to the profitable economies that lie immediately in sight through the application of modern methods in lieu of wasteful and antiquated practices.

A company operating in an isolated section has many problems besides the ordinary technical and commercial ones. Routine and surreptitious practices that develop under such circumstances become almost traditions; the long established customs of the workmen, the trade of the region, and in some instances the religion may have a handicapping effect on efficiency. It is interesting to note the care taken by the Lena Goldfields' directors in suggesting operating changes. Commenting on the recommendations made by their engineer, the Lena directors state that they "feel confident that the Lenskoi board will not allow a preference for what has become customary nor a misplaced leniency toward vested interests to interfere with the company's legitimate rights."

Germany's Foreign Interests in Metals

The animosities created by the war have resulted in many inconsistencies and many losses of common sense. This refers especially to our British friends, but some of the absurdities that are entertained in Great Britain are beginning to find currency here. We have especially in mind some hypotheses respecting the German control of the world's business in metals, other than iron and steel, that recently have been advanced.

Soon after the outbreak of the war, the Australian government raided the offices of the principal mining and metallurgical companies and of the metals merchandizing companies in Melbourne; and while no evidences of trading with the enemy were discovered, high Australian officials, speaking formally for the government, professed themselves shocked to find to what extent German interests controlled the markets for lead and spelter.

This was taken up in Great Britain as a surprising revelation of how the three great metal houses of Frankfurt am Main and Halberstadt had pulled the wool over the eyes of unsuspecting Britishers, Australians, Americans, and in short of about everybody who does not speak German; it was charged that the Frankfurt and Halberstadt houses masqueraded in foreign countries under assumed names; and finally, it was shouted that Britons, who ne'er were slaves, must promptly emancipate themselves from the bonds. This may have been the right kind of talk to address politically to the populace, but to persons of intelligence and information it has been disgusting. The principal facts are well known matter of historical record.

Nobody supposes that the right honorable gentlemen who sit in Westminster, or the Solons who grace Washington, or the political luminaries who shine in Ottawa and Melbourne, are acquainted either with the intricacies or the simple threads of the mining, metallurgical and metals merchandizing business, but among those concerned with that business there has never been any secret that the American Metal Co., in New York, and the Australian Metal Co., in Melbourne, were associated with the Metallgesellschaft of Frankfurt am Main; nor that other local firms, agencies and companies were related to Beer, Sondheimer & Co. of Frankfurt am Main, and Aron Hirsch & Sohn of Halberstadt.

It is also well known that the great mining companies of Australia, such as the Broken Hill Proprietary, the Zinc Corporation, the Sulphide Corporation, the Mount Morgan, the Mount Lyell, etc., are full-grown concerns, opulent and excellently managed, which are well able to look out for their own interests.

Some years ago, when the Broken Hill mines began to be large producers of zinc concentrate, the marketing of the immense tonnage that was foreseen immediately became a matter of great concern. The whole world had an equal opportunity to bid upon this business, but nobody could offer so good terms as the Germans, who had more experience in smelting lead-bearing zinc ore than anybody else. It was necessary for the Frankfurt and Halberstadt houses which entered into the contracts to provide additional smelting facilities, even building several new smelting works, and in view of the large outlay of capital they had to make, the contracts were drawn up to run for a long time. Previous to the war satisfaction with those contracts were emphatically expressed by the mining companies.

Let it be noted that the mining companies were in no way dragooned into the contracts, and were entirely free to do otherwise if they saw fit. Thus the Broken Hill Proprietary Company did erect a zinc smeltery at Port Pirie in Australia, and the Sulphide Corporation built a zinc smeltery at Cockle Creek in Australia, and through a subsidiary, the Central Zinc Co., erected a large plant at Seaton Carew on the northeast coast of England. If the British zinc smelters did not go after the Australian business, and if the Broken Hill companies did not, on their own account, go more extensively into smelting, it was their own fault.

With respect to the control of metal prices by the German houses, the international zinc convention was organized especially for that purpose, and the British smelters went into it along with the French and Belgian, for the reason that they expected thereby to get a better price for spelter than they would if there were unrestricted competition. This convention consisted of three groups, viz., the Zinkhüttenverband, comprising the German and certain of the Belgian smelters, a Franco-Belgian group and a British group. The Franco-Belgians and the British had the chief advantage, inasmuch as they were obligated only to regulate their production, otherwise being free to sell their product, the Zinkhüttenverband holding the umbrella, as we should say in our vernacular. Thus, there was no doubt rejoicing in England a year ago that the immense unsold stock of spelter was being lugged in Germany, although after the war began the Englishmen were very sorry they did not have it.

Similarly, the international lead convention was an undertaking in which the Australians, Spanish and other producers participated for the avowed purpose of getting a better price for their products than they would otherwise.

We are not defending the wisdom or equity of these price-regulating conventions. We are simply pointing out that although they were managed under German auspices, and perhaps were inspired in Germany, the British, and British Colonials, and Americans, and Spaniards, and the foreigners of almost all descriptions welcomed the chance to go into them, and neither then nor now had they any idea that they were innocents who might be misused.

The present great concern of the Australian zinc producing companies is that upon the outbreak of the war the market for their products was cut off, this resulting naturally in great loss to the producers, and great distress among their employees. Steps were immediately taken by certain of the companies to place their ore wherever they could, but there were no great possibilities. American smelters, in the main, were not situated geographically so as to take the Australian ore. The Central Zinc Co. promptly inaugurated plans to increase the capacity of its works at Seaton Carew, but otherwise the English and Welsh smelters do not appear to have been enterprising. In the meanwhile, certain of the great Australian companies made up their minds that they would have to pocket their losses, but that they would never let themselves be caught again in such a fix, and would immediately prepare to provide their own smelting facilities, even if it should take two years (which was reckoned as the minimum time) to do so. This involved the expendi-

ture of a vast amount of money, and for the sake of its financial assistance and smelting experience, the American Smelting & Refining Co. was invited to participate in the new plan.

The plan for the new smelting program was regarded as all but consummated when we said something about it several months ago. It fell through for several reasons. We understand that the A. S. & R. Co. insisted that the works should be on this side of the Atlantic. Some of the important British interests thought that America was the better locus for the business and that it ought to be here; but others was averse to letting the plants be erected anywhere outside of Great Britain. The great obstacle, however, was the intimation by the German houses to the A. S. & R. Co. that it would be going into a lawsuit and would be held responsible for the breaking of the ore contracts. We have good reason to suppose that the A. S. & R. Co. was quite innocent of any malevolence, but it might have been easier to strike than the foreign interests. The belief of the Australian companies had been that their contracts were automatically broken by the war. The Frankfurt and Halberstadt houses claimed that they were merely suspended. Efforts have been made to obtain a judicial pronouncement respecting this, but so far that has not been found possible to obtain.

The entry of the American Smelting & Refining Co. into the business in the first place was not another attempt of a devilish foreigner to rob the guileless Briton of his own, but was because the projected smelting plans required millions and millions of money, and American assistance, both financial and technical, was desired and was invited.

The latest absurdity about the lead and spelter business is the intimation that "the fine Italian hand" of the "German agencies" in New York is responsible for the recent extravagant rise in the price for spelter. It is all so very simple, thus: "England wants to buy spelter to keep it out of the hands of the Germans, who might make bullets out of it. The Germans, who monopolize the selling of spelter in New York, cornered the supply so as to make the British pay 'through the nose' for all they had to purchase in order to keep the Germans themselves from getting it." More fallacies are crowded into these few sentences, which are attributed to a "spelter interest," than can often be found in the same space.

Spelter is not used for making bullets. Spelter is the one metal whereof the Germans have more than they know what to do with. England had to buy her supply of spelter in America, because her previous supply from Belgium and Germany had been cut off. The zinc business of the United States is not controlled by the Frankfurt and Halberstadt houses, nor by Germans, nor by German-Americans.

We have not offered these comments because we hold any brief for the Germans in these days of controversy and hard feelings. But our sense of fairness caused us to think that something ought to be said on this subject. What we have said herein relates wholly to matters that are of historical record in our own files and in those of other reputable publications. It is quite time that common sense should once more begin to prevail.

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The meeting of the American Institute of Mining Engineers to be held in New York next week promises to be very well attended. These mid-winter meetings at the headquarters of the organization are becoming an appreciated feature in the life of the Institute.

BY THE WAY

This may sound like a joke, but it is not. A certain zinc smelter reports that he is now getting everything out of his ore but the "squeal." Asked to explain what he meant, he said that he is now putting up in barrels the residuum from his retorts and selling it as a specific against hog cholera. There is active demand for the substance for that purpose. It is said that the zinc residuum spread over the hog yard stamps out the germs of hog cholera and the hogs experience no further trouble. Nobody offers any explanation. This is simply reported as a thing that is so.

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The absence of authoritative quotations for the price of lead in London during August-October, 1914, produced a complicated question between the miners and smelters of British Columbia in connection with the Dominion bounty which is based upon the London price for lead. The arbitrator, C. R. Hamilton, of Nelson, decided that inasmuch as quotations had practically been forbidden after the outbreak of the war no data of any kind for the period in question should be officially recognized and certain pending settlements were ordered made at the average for the first seven months of 1914.

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Metall und Erz gives a list, comprising 104 names, of the members of the Gesellschaft deutscher Metallhütten und Bergleute who have gone to the front. In characteristic German fashion, the full titles of each individual are given, so that the items are very long, six or seven lines being required in some cases, although all possible abbreviations are used. They are serving in various capacities; for example, William M. Guerthler, Ph.D., is driver of a motor truck. The following members well known in this country are included in the list: Alexander Becker, director of the Metallbank, Frankfurt; Ernst Gellbach, director of the Hohenlohehütte; Theo Goldschmidt; Wilhelm Goetzke; Julius Grillo; Prof. F. Jungst, of Clausthal; Max Mehler; Wilhelm Schulte; Walther Selve; and Doctor Vogelsang, of Eisleben.

⁂

When men of primitive instincts search for gold in remote regions, rivalry often leads to bloody strife. One rather ludicrous instance of somewhat reversed conditions is revealed by a study of the history of Brazil. During the seventeeth century adventurers from Sao Paulo roamed about the headwaters of the Maranhao River, in what is now the State of Goyaz. They sought gold with such success that Pedro Cesar de Menezes, governor of Para, resented what he considered trespass upon his domain. In 1673 he sent an armed expedition against Pascoal Paes de Aranjo, the leader of the *"paulistas."* The expected battle did not take place, because the attacking soldiers went into the mining business on their own account, under the kindly guidance and tuition of Pascoal Paes de Aranjo.

PERSONALS

Wilfred Bancroft, secretary and treasurer of the Mass Consolidated Copper Co., visited the mine near Houghton, Mich., last week.

George Howard Ferguson is now Minister of Lands, Forests and Mines of the Province of Ontario. He is a lawyer, a graduate of Toronto University and has been a member of the Ontario Parliament for nine years.

Robert Walker for a number of years underground superintendent for the North Star Mines Co. at Grass Valley, Calif., has been retired on a pension. He is the first employee retired under a system adopted by the company. He has been in poor health.

Allen Hoffer, Jr., who has been assistant superintendent of the Warwick furnaces of the Eastern Steel Co., Pottstown, Penn., has been made superintendent of the blast-furnace department of the Worth Brothers Co., Coatesville, Penn., and has taken charge of his new work.

H. C. Felver, who has been in charge of the Worden-Allen interests in the Michigan copper country for the past six years and has built practically all of the steel construction work for mining interests there, has been promoted to an important executive position with the company at its Buffalo branch. Mr. Felver has just returned from an extended visit to France in the interests of the Worden-Allen corporation.

OBITUARY

David Carlyle Reed died at Barranca, Peru, Jan. 6, aged 41 years. He was born at Jamestown, N. Y., and graduated from Columbia School of Mines, New York. He went to Peru in 1904 as chief engineer to Frank Klepetko. He remained with Mr. Klepetko for seven years and during that time gathered an immense amount of information respecting the mineral resources of the country, in connection with Mr. Klepetko's extensive prospecting operations. Later Mr. Reed was given the contract to make the necessary surveys and estimates for the proposed railway from Huancayo to Ayacucho, the contract of which was being considered at that time by the Eddy Construction Co. Although Mr. Reed completed this work, the Eddy bid was finally rejected by the Government. Consideration, however, has recently been given to the project and it is very probable that Mr. Reed's recommendations will be carried out. Last year, Mr. Reed secured the contract for the construction of the Cuzco-Sta. Ana railway and the work was proceeding in a satisfactory manner, when the financial crisis precipitated by the European War caused its suspension. Since the war Mr. Reed had spent part of his time in the South endeavoring to arrange for the continuance of the work. He returned from Cuzco to Lima about the end of December suffering from heart disease caused by work at high altitudes. He left a widow and four boys.

SOCIETIES

Mining Society of Nova Scotia—In view of the unusual conditions prevailing the Council has decided not to hold the usual annual meeting and dinner this year. A formal annual meeting will be held, as directed by the charter, to elect officers and transact necessary business.

Institution of Mining & Metallurgy—His Majesty, the King of England, signalized the opening of the new year by conferring a Royal Charter of Incorporation upon the Institution of Mining & Metallurgy. This organization is to be congratulated on the success which has finally attended its efforts to obtain official recognition.

Canadian Mining Institute—The seventeenth annual meeting will be held in Toronto, March 3, 4 and 5. The headquarters will be at the King Edward Hotel. A. J. Young, Traders' Bank Building, is chairman of the Toronto local committee.

The business will include the report of the Council and financial statement for the year 1914; the election of the Council for 1915-16, and consideration of the proposed amendments to the by-laws.

Among others the following papers will be presented for discussion:

"The Zinc Industry in America," by J. A. Van Mater, New York.

"The Hall Sulphur Process," by H. F. Wierum, New York.

"The Stimulation of Prospecting," a symposium, by H. E. T. Haultain, Toronto; J. M. Bell, Montreal; and J. E. Hardman, Montreal.

"Safety Engineering at the Canadian Copper Company's Works and Mines, Copper Cliff, Ont.," by E. T. Corkill, Copper Cliff, Ont.

"Recent Developments in the Gold-Dredging Industry in the Yukon," by O. B. Perry, New York.

"The Economic Possibilities of the Yukon," by D. D Cairnes, Ottawa.

"The Ore Deposits of the Copper Mountains, Similkameen, B. C.," by Frederic Keffer, Greenwood, B. C.

"The Smelting of Titaniferous Ores in the Blast Furnace," by Bradley Stoughton, New York.

"The Oxygen Torch," by David H. Browne, New York.

"The Weedon or McDonald Mine, Weedon, Que.," by L. D. Adams, Weedon.

"Certain Canadian Minerals for which a Demand has been Created as a Result of the War," by R. A. A. Johnston, Ottawa.

"Some Notes on Modern Hoisting Machinery," by J. B. Porter, Montreal.

"Some Recent Developments in Metallurgy," by A. Stansfield, Montreal.

"Gold on the North Saskatchewan River," by J. B. Tyrrell, Toronto.

"The Beaver Lake Gold District," by E. L. Bruce, Ottawa.

"The Conservation of our Mineral Resources," by F. D. Adams, Montreal.

"The Alberta Oil Fields," by D. B. Dowling, Ottawa.

"The Ore Deposits of the Ainsworth Mining Camp," by S. J. Schofield, Ottawa.

INDUSTRIAL NEWS

J. H. Dougherty, formerly with the International Steam Pump Co., has been engaged by the Northern Equipment Co. to take charge of centrifugal pump design and the improvement and development of the Erie line of centrifugals.

Guy E. Marion, secretary-treasurer of the Special Libraries Association, has severed his connection with Arthur D. Little, Inc., and will devote himself to the organization and development of special libraries or information departments, in business houses, industrial plants, etc. Mr. Marion will have offices after Feb. 1, in the Tremont Building, Boston, Massachusetts.

The International High Speed Steel Co., of 478 Pearl St., New York, has acquired a tract of nine acres of land at Franklin, near Rockaway, N. J., on which it will erect a large plant for the manufacture of its Bulldog brand of hollow and solid mining drill steel, and also of high-speed, tool and automobile steels of every description. It is expected that the plant will be in operation by April.

The Industrial Works of Bay City, Mich., has added to its extensive line of locomotive and wrecking cranes a small locomotive bucket crane operated by a gasoline engine. Such a crane is especially adapted for light or intermittent work, such as handling coal, ashes, etc., or for service in places where the use of steam is objectionable. A crane of this type has a further advantage in that it is always available for immediate use without waiting to get up steam. In operation it should be very economical, as there is no waste of fuel when the crane is not actually working.

One of the new industries of Chattanooga is the shovel factory of the American Manufacturing Co. This firm, which for many years has been manufacturing hardware specialties, recently purchased the plant and equipment of the Owensboro Shovel & Tool Co., of Owensboro, Ky. The equipment has been installed in the Chattanooga plant and will be ready for operation in a few weeks. The company expects to start modestly at first with an output of perhaps 75 dozen shovels a day, including long and "D" handle shovels, spades and scoops, gradually increasing the output as necessity demands it. In the manufacture of shovels in Chattanooga, the American Manufacturing Co., expects to do much of the work electrically as it is expert in this line of endeavor. It was among the first to purchase an electric welding machine in the general manufacturing business 12 years ago, and it has been instrumental in developing the uses of these machines and increasing their possibilities. Many of its improvements have been adopted by makers of these machines.

Editorial Correspondence

SAN FRANCISCO—Feb. 3

In Southern Eldorado County the outlook for the gold-mining industry on the Mother Lode for the coming year is exceedingly bright. Both the Nashville-Montezuma group of mines and the Church-Union mine, which have been under bond to Errol MacBoyle of San Francisco, are to be reopened. The Nashville-Montezuma mines were taken over by Bewick, Moreing & Co. of London, operators of the Plymouth Consolidated mine at Plymouth, about six miles south of Nashville. The Nashville mines were equipped and unwatered last summer but were closed in August on account of the European financial situation. An extension of the option, however, has been secured by Bewick, Moreing & Co. and development will again be undertaken in the spring. The Church-Union or Springfield mine, which is credited with a production of $6,000,000, was one of the well known Mother Lode mines in the '70s when it was owned by Hayward & Hobart who then controlled such famous mines as the old Eureka-Hayward mine, the Plymouth, and the Utica mines. The Union mine has now been acquired by John A. Finch of Spokane, who, with H. H. Lang and Mr. MacBoyle, has recently been in Eldorado completing arrangements for the reopening of the property. Mr. Finch is an owner of the Standard Silver-Lead mine in British Columbia and is one of the largest mining operators of the Northwest. With the Church-Union and Nashville mines again in the hands of operators having ample capital for systematic development work, and with interest being shown in a number of the smaller mines and prospects, southern Eldorado County seems to be on the eve of rejuvenation and it is confidently expected that this district will become as prolific a producer as any portion of the Mother Lode in Amador County adjoining.

Legislation affecting deep mines, introduced in the present legislature, will receive more careful attention from state officials and metal producers than formerly. The California Metal Producers' Association has undertaken an important duty relative to the safety of workmen by its purposed co-operation with the Industrial Accident Commission. It has been agreed between the association and the commission that a committee shall be appointed composed of three metal-mine operators, three skilled miners employed in deep mining, and H. M. Wolfin, mining engineer, in charge of the mine safety department of the commission. This committee of seven should be found more competent to formulate rules for safe operation of deep mines than could be provided in a legislative bill. The compensation law provides for mine inspection, but does not prescribe a system or rules of inspection. That is left to the mine-safety department, which in turn holds the mining engineer of that department responsible. Any system of inspection or rules prescribing the duties of the inspectors may be adopted and put into operation by the commission under the provisions of the compensation law. There have been introduced in the legislature five bills purporting to benefit the miner. One of these provides for the regulation of drilling and is known as the "dust law." Another provides for the elimination of foreigners unable to speak and understand the English language. Another is known as the "bank-to-bank law," providing for the regulation of the beginning and ending of a shift of labor underground. There is a hospital bill, and a bill for the examination of persons who handle steam-driven machines.

DENVER—Feb. 4

The Cresson shipment sampling has encountered difficulties. About 162 tons of the bonanza stuff was sacked as two lots. These lots were first delivered to the Copeland sampling works in the Cripple Creek district where they were crushed, rolled and automatically sampled, four pulps being thus prepared from each lot. It is claimed that the assays of these control samples checked up closely, the average result for the first-class being about 206 oz. gold per ton, the average for the second-class being about 105 oz. per ton. The stuff was next shipped to the Globe plant of the A. S. & R. Co., Denver, where the utmost pains were exercised in resampling; the ore was rerolled and by automatic, mechanical methods four distinct samples were again secured from each lot. Upon assaying, the four samples in each set checked up among themselves within 1½% variation, which appears somewhat remarkable for such ore. Still, there is an apparent discrepancy of about $35,000 between the gross values determined in Victor and in Denver, the latter result being the lower. At this writing, the lots, which are intact at the smelting plant, are to be again completely rolled and sampled in a final effort to reach a settlement satisfactory to all concerned. The Copeland plant is presumed to have purchased the ore on its own samples and is naturally standing out against an indicated dead loss of about 7½% on the transaction. There are no metallics in this rich ore.

SALT LAKE CITY—Feb. 4

The Hercules Powder Co. is expected to begin production in March, having nearly completed its plant at Bacchus, half way between Bingham and the Magna mill of the Utah Copper. A tract of 2500 acres has been acquired, and cottages for employees, boarding house, club, golf links, etc., built. The plant will have a monthly capacity of 1,250,000 lb. of dynamite and 15,000 kegs of black powder. The buildings in which the powder will be made are isolated and surrounded by earth embankments. The site of the factory is on the west bench overlooking Salt Lake Valley, on the line of the Bingham & Garfield road.

The Daly-Judge at Park City on Feb. 3 laid off 50 miners, on account of efforts on the part of a deputy state labor commissioner to enforce the eight-hour state law. Owing to the winter shortage of water it had not been possible to work two shifts at the mill to advantage, and the men were being worked an additional two hours. Wages were being paid for overtime. During the last week in January 30 women applied to the superintendent of the mine for work for their husbands. In order to take in such men and to relieve the present situation somewhat the mill was running a little overtime. The mine was running at the regular eight-hour rate. The overtime at the mill was introduced to take care of surplus ore which could not be treated in the eight-hour shift. On account of the present low metal prices, no effort is being made to crowd production. The 50 men laid off had been producing the ore treated in the overtime. A canvas among the men at the mill showed that, without exception, they were well satisfied with the overtime arrangement and glad to earn the extra money. The working force at the Daly-Judge amounts to 250 to 275 men.

JOPLIN—Feb. 6

Numerous New Mills are being built, old mills started up, new shafts sunk and old ones cleaned out and repaired, preparatory to opening up new mines and starting up old ones. Outlying districts such as Sarcoxie, Wentworth, Aurora and a number of other small camps are feeling the effects of the good market. Many good new strikes are being reported from these camps recently; the most noticeable is that made at the Boyd mine which after a number of years of varied luck has at last opened a good body of pay ore; a mill of 350 tons capacity is now running on full time and turning out two carloads of zinc concentrates each week. The Prosperity Camp is a scene of much greater activity than formerly, the last two months marked the erection of two new 350-ton mills and the starting of another. The McDonald company having just completed its mill will begin operations in a few days; the F. C. Wallower mill has been running for about 30 days; while the Jasper County Milling Co. will be ready for operation in a short time. These mills are all handling the deep sheet-ground ores which can be mined profitably only when zinc ore is selling above a $40 base. With the present high prices excellent profits can be made and it is to be expected that a large number of new companies will get into the sheet-ground district.

ISHPEMING—Feb. 6

The Oliver Company, it was frequently stated last year, would push its mining operations on the old ranges after the first of the present year, when the leases on the Hill lands expired. It was thought that many properties which have been idle for years or which have been carrying on operations on a small scale would be greatly benefited because the Steel Corporation would lose a number of mines on the Mesabi. At the present time it does not look as if such would be the case, since the Corporation can purchase ore in Minnesota at about the same figure that it can be mined from

some of its own mines in Michigan. Most of the Michigan properties are held in fee and the ores are being held as reserves, while more activity is shown at the mines that are held under lease and upon which royalties have to be paid annually. The Steel Corporation owns several mines in the Ishpeming field, about half of which have been idle for a number of years. The mines at Champion and Section 21 at the Winthrop are good examples. The reserves of these properties are known to be large but the company does not show any disposition to mine the ore. If the demand for ore were brisk and the price high, some attempt might be made to place these ores on the market. Right now it is difficult to see how the old ranges are going to be benefited because the Hill leases have expired. The Arthur Mining Co. has been formed to take over the Hill lands and operate the mines relinquished by the Corporation. Many new mines are also being developed by this concern and the company will have a large tonnage within a year or two to place on the market for sale. Some persons feared that the entry of the Arthur would have some effect on prices but all such talk has ceased since M. A. Hanna & Co. took a contract to sell the ore. The Hanna company has its own ores to sell and could not afford to try and dispose of the ores of the Arthur at a lower figure. Just now all of the iron-mining companies are wondering what the demands of the furnaces will be this year and what the prices will be. Only a few sales have been reported thus far and the price per ton has not been made public. Most of the ore contracts are usually made in February and March, although last year they came in later.

HOUGHTON—Feb. 6

Full Time operations are now being carried on by every copper-producing mine in the Lake Superior district. The net increase in the output of refined mineral is likely to show over 2,000,000 lb. in February and 2,500,000 lb. in March. This additional copper will not, of course, reach the market before April and will not have any appreciable effect on the supply until later in the spring. The following table shows the total monthly rock output at every mine in the district with the approximate net refined output in copper. The estimates are conservatively figured, based on the past performances in the returns per ton:

Mine	Monthly Rock Tonnage	Refined Output Pounds of Copper
Calumet & Hecla	208,000	5,625,000
Ahmeek	62,500	1,500,000
Winona	5,200	104,000
Quincy	104,000	1,560,000
Superior	19,000	350,000
Mass Con.	21,000	420,000
Centennial	13,000	170,000
Wolverine	44,200	800,000
Osceola Con.	105,000	1,600,000
Isle Royale	57,200	940,000
Allouez	41,600	637,500
Mohawk	60,000	1,300,000
Victoria	7,800	93,600
Champion	70,200	1,479,000
Trimountain	34,000	550,000
Baltic	37,000	730,000

In the case of Mass, the figures apparently show a net return of 20 lb. to the ton on the tonnage. That is not true, for the Mass does not run so high. The unusual amount of solid mass stuff that is smelted direct brings up the average of the Mass return on the mill material appreciably. Calumet & Hecla and all its subsidiaries were the last mines to return to normal working time. Wolverine and Mohawk kept up full time all through the slump. Baltic, Champion and Trimountain went on half time and just a few weeks ago resumed full time. Quincy has been working full time but operating three shafts only. Other smaller mines worked full time.

TORONTO—Feb. 6

The Hollinger annual report, which was presented at the annual meeting of the shareholders in Montreal, Feb. 2, was satisfactory, and shows that the property will have a great future. It is now numbered among the great gold mines of the world, and in another year or two, when further work has been done, it should stand near the head of the list. During the past year the mill treated a total of 208,936 tons and recovered bullion to the value of $2,688,354, an increase of $222,134 over the preceeding year. The net profits for the year were $1,786,679 or practically 60% on the $3,000,000 issued capital. Dividends of $1,170,000 were paid. The surplus carried forward was $1,126,743, and of this amount $664,603 represents cash and gold bullion. Expenditures for plant amounted to $305,621, and when the present additions to the mill are completed, the capacity will have been raised from 500 to 1600 tons a day. The average value of the ore treated during the year was $13.67 as against an estimated value for the reserves given in last years' report of $13.71. Operating costs were reduced to $4.50 a ton, and at the present time are lower than this average. Further reductions will be made. The ore reserves are estimated at 1,162,960 tons, having an average value of $11.49, giving an estimated gross value of $13,358,420. This represents an increase in gross value over the preceeding year of approximately $2,000,000. In addition to this there are a large number of known veins on the property some of which have been found by diamond drilling, on which no work has been done and on which no tonnage estimates could be made. Out of a total of 54 veins located, so far only 12 have been reached by underground workings. One of the most interesting sections of the report was that dealing with the deep diamond-drill exploration. An incline hole was bored to a depth of 2000 ft. and reached a vertical depth of 1450 ft. In the course of drilling 13 mineralized zones were passed through, the last, at a depth of 1424 ft., being 7 ft. wide and assaying $8 a ton. Of the 13 orebodies cut by the drill, six were 5 ft. or more in width, and nine sampled $6 or more to the ton; one at a depth of 710 ft. averaged $23.60 a ton. The information furnished by the diamond drilling shows that there is no change in the formation to a depth of 1425 ft., and also that at that depth there is no change in the vein characteristics. The content shown is such as might be expected if the hole had been bored at any random point below the 200-ft. level. As a result of this drilling, it is considered reasonable to assume that operations can be carried to a depth of at least 1500 ft., and there is nothing yet to indicate that a much greater depth may not be obtained.

The Nickel export question will come prominently before the Canadian Parliament which opened Feb. 4. W. F. MacLean, M. P. for South York, has given notice of a bill to be introduced next week to regulate the exportation of nickel and combinations thereof. It entirely prohibits the export of nickel ore, nickel matte, nickel oxide and all compounds of nickel during the present war or at any time when the Empire is at war. It also provides that the export in times of peace shall be subject to regulations made by the Governor-in-Council, under which authority the government might easily compel the producers to refine all nickel in Canada. The last clause of the bill permits the shipment of nickel and nickel compounds to the United Kingdom for use in war times. Mr. MacLean is an independent Conservative and an ultra-protectionist, and through his newspaper, the "Toronto World," has been the leading promoter of the agitation, which though studiously ignored by both the Government and the Liberal press appears lately to be gathering strength. A large number of petitions asking Parliament to prohibit the export of nickel are being received by members. Several boards of trade including those of Ottawa, Berlin, and Owen Sound have taken up the question and while not favoring so drastic a measure as the prohibition of nickel exports, have passed resolutions to the effect that the Canadian and provincial governments shall be asked to take measures providing for the refining of nickel in Canada, and that a commission be appointed to investigate the matter of the erection of a refining plant in Ontario, thereby reserving to Canada complete control of all nickel mined in the country. So far nothing has happened to indicate any change of policy on the part of the government, and in view of the strength of the administration and the strictness of party discipline, coupled with the evident indisposition on the part of the Opposition to identify itself with the movement, it is altogether improbable that Mr. MacLean's action will result in any serious interference with the industry. It is pointed out by those opposed that the immediate result of its adoption would be to increase greatly the opportunity of the Germans for obtaining nickel from the United States, since, were further exportation prohibited, the International Nickel Co. would naturally seek to dispose of the large stocks now on hand to the best advantage and would have no object in refusing to sell to Germany. This is a consideration which the government is not likely to overlook.

The Hon. G. Howard Ferguson, Minister of Mines for Ontario, has announced that a commission will be appointed to investigate the situation. This commission, the members of which have not yet been appointed, will deal largely with the question as to whether or not it is economically feasible to refine the nickel matte in Canada. It will also take up the question as to whether the nickel companies are paying a fair rate of taxation. The majority of mining companies in Ontario, pay 3% of the profits over a certain exemption, but the nickel companies pay on the value of the nickel in the matte, and this value is much lower than the published quotations for nickel even allowing for the cost of refining. Mr. Ferguson considers that while a few years ago the refining of nickel in Canada would not have been economically feasible, the rapid advances in metallurgy demand a complete investigation, to decide whether or not the time has arrived when such a step should be made. Unfortunately for this side of the matter, the recent advances in metallurgy do not seem to have helped the nickel refiners to any extent.

The Mining News

ALASKA

IN HEALY RIVER DISTRICT no real pay yet found. Owing to litigation, Lawrence & Albrecht, who took in a large plant from Tenderfoot district last fall, have been unable to start work.

BROAD PASS district reports, probably exaggerated, state two lodes, 200 to 250 ft. wide, have been traced for several miles. One lode runs $15 clear across, has streak 14 ft. wide assaying $250. Wells Bros., reported to have sold out for $150,000, had known of veins for several years. Under present conditions this not poor man's camp.

KOYUKUK DISTRICT reports unusual activity this winter. Camp consistent producer for 20 yr. Corbett Bros. working on lower Hammond River; Averill & Trail on Jennie Creek; Gilbert & Ellingson on Discovery, Hammond River; Dow & Collins, Butler & Hastings, Siverly & Brown, Kelly & Geegan and Vern Watts all on Hoosier Association claim, Hammond River; Smith & Ellingson on No. 4; Crawford on No. 5; Martin on No. 6. Wild Creek district looking good. Joe Matthews, on Discovery, Joe Creek, took out $5000 last fall before freezeup, in seven box-lengths (84 ft.). Jack Sullivan, on No. 1 Below, panned 83 oz. of gold dust from drain 3 ft. wide, 4 ft. deep, and 16 ft. long. Larsen and partners, on Nos. 1 and 2 Above, recovered $3500 from five box-lengths.

JANOFF & CO. (Fairbanks)—Boilerhouse on No. 14 Goldstream destroyed by fire. Total loss, $1000. Thought caused by candle left burning.

TREADWELL GROUP (Treadwell)—Treadwell mills crushed 61,341 tons in December recovering free gold $73,912 and concentrates $53,802. Corresponding figures for United, 39,361 tons, $51,861 and $42,327; for Mexican, 19,040 tons, $20,521 and $22,292.

BITTEL & OSBORN (Ruby)—While prospecting for gold on Poorman Creek, operators discovered coal seam at bottom of 60-ft. shaft. Coal much crushed; bed appears to dip about 45°; thickness not determined. Said to be of good quality, possibly semi-anthracite.

NO. 4 BELOW, GOLDSTREAM CREEK (Fairbanks)—Gleason & Sawyer, laymen, have blocked out 20,000 sq.ft. of pay that they expect to hoist this winter. Operators have novel type of plant, using gasoline engine situated underground for hoisting, in conjunction with Fairbanks overhead carrier. Bucket dumps automatically, doing away with necessity for top man and for expensive surface equipment during cold weather.

HOT SPRINGS DISTRICT—Fred Jorgensen, layman on Bock ground, reported to have found good pay. Has enough ground blocked out to assure full summer's work. Three churn drills being used in prospecting at Hot Springs, two on Bock's ground, other on ground controlled by Howell & Cleveland. More prospecting for quartz deposits, both gold- and tin-bearing, than in former years. Some promising discoveries made, but nothing to arouse undue enthusiasm.

BERRY DREDGE—Nels Rasmussen has contract to move new Berry dredge from steamboat landing at Circle City to diggings on Mammoth Creek, distance of about 35 miles. Work of moving progressing satisfactorily, dredge will be ready to start digging when water runs in spring. William McDonough, who has contract to deliver wood to dredge, recently left Fairbanks with 14 head of horses to commence work.

ARIZONA

Cochise County

MASCOT (Dos Cabezas)—Reported railroad will be built to connect with Southern Pacific at Wilcox instead of with El Paso & Southwestern at Kelton. Great joy in Wilcox; free barbecue announced to celebrate beginning of work;—and Arizona has a prohibition law.

Gila County

INSPIRATION (Miami)—Now stated production should begin in April. Final decision not made as regards some machinery. Minerals Separation process to be used on royalty agreement.

Greenlee County

SHANNON (Clifton)—Reported orders given for immediate resumption, after about five months' shutdown. Shutdown calculated to have cost about $10,000 per month. Production now should be about normal, 1,000,000 lb. per month.

Santa Cruz County

R. R. R. (Patagonia)—A. E. Crepin has sold interest in this producer to Colonel Richardson, of Patagonia, and has moved to Tucson.

CONGRESSIONAL (Alto)—Josiah Bond, owner, has completed wagon road to mine, and machinery to sink main shaft deeper will be installed.

RIQUEZA (Alto)—This mine, belonging to Josiah Bond, under lease to Figueroa Bros. who are mining high-grade silver ore. Shipment will go forward this month.

DUQUESNE (Duquesne)—Mine has large amount of fair shipping ore in sight, which will be sent to smelter as fast as conditions of road will allow. Rains of January have been unusual, with considerable damage to every road in county.

CALIFORNIA

Calaveras County

FORD (San Andreas)—Option taken some time ago by John S. Benson. Mine will be unwatered and retimbered. Situated on Mother Lode and has well known characteristics of belt. Sixty acres of Ford south extension bonded to Eastern men.

ORO WATER, LIGHT & POWER CO. (Oroville)—Company contemplates extending dredging operations in this county. Arrangements reported for additional mining rights on ranch owned by Irving Hill, situated on Mokelumne River near Comanche.

SMITH RANCH (Campo Seco)—Mining rights bonded to W. E. Booker and others, and subleases let; the 45-ft. shaft being deepened to tap Fleming dike. Incline tunnel on another lease about 30 ft. in being advanced in good ground. Good ore being extracted from 30-ft. shaft on King lease.

Mariposa County

MARIPOSA COMMERCIAL & MINING CO. (San Francisco)—Suit for $1,142,301 damages filed at Oakland by George W. Lanyan, assignee of claims, for alleged breach of contract in refusing to sell Fremont Grant for $400,000. Claimants were S. Webber Parker and William H. Cook. Fremont Grant has been for sale for some time and number of different promoters or agents have undertaken to handle it. Grant contains mines as well as agricultural and grazing lands.

Placer County

ORO FINA MINING CO. (Auburn)—Capital stock of $100,000 to be increased to $200,000. Resolution to this effect was adopted in October.

WHISKY DIGGINGS (Lincoln)—Old mine being reopened by tunnel. Shaft will not be repaired at present. Ore carries lead, zinc, gold and some copper. Ores will be shipped to Selby. Operators San Francisco men.

San Benito County

NEW IDRIA (Idria)—Large shipment of quicksilver shipped to New York last week of January. First shipment direct to New York market in several months. To be sold at whatever New York price may be, as price is better there than in San Francisco.

San Bernardino County

BAGDAD MINING & MILLING CO. (Bagdad)—Company dissolved on account of nonpayment of taxes. New company reported to be contemplated by some of former owners.

COLORADO

Boulder County

COPPER GLANCE (Sunset)—W. J. Barrett has sold this group to newly incorporated Sunrise M. & M. Co., W. J. Hegel, president, and W. A. Notie, secretary-treasurer, Denver. Small mill to be erected.

U. S. GOLD CORPORATION (Boulder)—Mill nearing completion. Herreshoff roaster under construction and will be ready for operation in near future. No. 2 shaft unwatered to bottom and electric pump installed; 170-ft. and 400-ft. levels being opened and development will be resumed.

CARIMAN MINING & MILLING CO. (Boulder)—Company formed to develop and operate Caribou-Poorman group of properties controlling important system of veins for distance of about two miles. H. P. Low and C. B. Manville chief owners and N. H. Brown general superintendent. Company plans to develop mines at greater depth through Boulder County tunnel now 4600 ft. long. Tunnel will be advanced 7000 ft. to develop Caribou vein at depth of 1680 ft. below surface. Present surface equipment includes mining plant and mill at Caribou, mining plant at Boulder County tunnel and concentrating mill at Cardinal. Last named plant has been in satisfactory operation since last July and has capacity of about 100 tons a day. On account of unfavorable condition of old Caribou shaft company plans to make No Name its principal working shaft. Extensive improvements will be made in surface equipment at No Name. Underground workings being cleared and repaired preparatory to resumption of active mining operations. In meantime company's milling plants kept busy treating ore sorted from extensive dumps of Caribou, Poorman, and No Name mines. Estimated these dumps contain 250,000 tons of material that can be milled at a small profit. Extensive tests made and considerable dump material found to average about $6. New mill for treatment of dump material has capacity of 150 tons a day. Dump material scooped up by specially designed scraper and delivered to mill storage bins; crushed in Blake crusher and reduced by 6-ft. Hardinge ball mill to 30 mesh. Oversize delivered to 4½-ft. ball mill. Cyanide solution introduced at ball mill and treatment thereafter in solution. Pulp from crushing department passed to Flood classifiers and thence to battery of Wilfley and Card tables where heavy sulphide minerals are recovered. Middlings reground and returned to tables. Tailings passed to Dorr classifier. Sand delivered to three large leaching tanks. Slime goes to three Dorr agitators and two Dorr thickeners, thence to Portland filter. Precipitation accomplished on zinc shavings. Mill arranged on gravity system and only elevator and pump used are to return middlings and handle solutions. Claimed mill makes saving of 90% of metal in ore at cost of $2.83 a ton. Claimed that orebodies now being opened underground are from 10 to 15 ft. wide with substantial quantities of $16 ore being developed. Company plans extensive campaign of vigorous underground development.

Clear Creek County

PHOENIX (Idaho Springs)—Property leased to Ed Mosher who will operate mine through Newhouse tunnel. Lessee plans to begin unwatering operations in near future.

LAKE (Idaho Springs)—Surface workings leased to E. D. Quigley. Lessee clearing out Lake tunnel No. 2 which will be advanced 150 ft. Sinking on vein to depth of 600 ft. below this tunnel under consideration.

Gilpin County

PRIZE MINING CO. (Nevadaville)—Company has commenced work on Prize, Prize Extension, Suderberg and Ashtabula properties, all of which will be worked through Newhouse tunnel. Drifts east and west from tunnel have been started and 400-ft. raise will be made to connect with old workings from surface. Company will repair equipment in Nevadaville and arrange to work over old dumps which contain considerable milling ore. Ore now produced from development is sent to Argo mill for treatment.

Lake County

BIG FOUR (Leadville)—This property, leased to Big Five Operating Co., will probably hereafter be worked through Yak Tunnel. After recent fire that destroyed surface plant and permitted workings to flood, negotiations were made with owners of Ibex property whereby Big Four acquires lease to considerable area of contiguous Ibex ground and will develop it by lateral from Little Jonny workings toward Big Four shaft. There will be about 749 ft. of drifting and 202 ft. of raising to effect connection.

Teller County.

GRANITE CONSOLIDATED (Victor)—This company owned chiefly by McNeil and Penrose interests has purchased holdings of Ophir Gold Mining & Milling Co. comprising about 18 acres of choice land practically contiguous to Granite territory on Battle Mountain in Cripple Creek district. Ophir company has been controlled by Dennis Sullivan of Denver and Grant B. Schley of New York.

IDAHO

CROWN POINT (Silver King)—Leasers have made arrangements with Federal Mining & Smelting Co. to treat ore from Crown Point in Sweeny mill. Mining will be resumed at once.

INTERSTATE (Sunset)—Plans to enlarge present concentrating plant to handle 400 tons per day. Capacity now 300 tons. Pumps will supply additional water if necessary. C. M. Loeb and Otto Sussman, of New York, have been at mine on business this week. High price of spelter stimulated activity at mine. Mill now producing 150 tons of concentrates daily.

MICHIGAN

Copper

MASS CONSOLIDATED (Mass)—Most satisfactory physical conditions exist in development and operation of Evergreen lode. Never before possible to maintain operations here during such a period of depression. Usually necessary to suspend work when copper touched 12c. or even before on declining market. While there was no profit in operations with copper at 11c., it was advantageous for corporation to keep mine in operation and doubly advantageous for men employed. Rights for extensive operation of Evergreen lode obtained three years ago, bulk of last assessment being used for that purpose. Lode, operated from B shaft, has shown more extensive mass and barrel work than ever before, wider and richer than ordinarily opened. On 6th and 8th levels showing has been good, permitting judicious selection of rock and furnishing large amount of mass and barrel work. Opening from 11th has likewise proved remunerative. On this lode, as on Butler lode, where most of mining continues to be done, careful selection of rock can run milling returns up to 25 lb. if desirable, but at higher milling cost, higher mining cost and smaller rock tonnage. On the other hand, rock can be sent to mill in such enormous quantities that it will average 10 lb. return. Question of selection is one which depends entirely on commercial possibilities as figured on possible selling price of output, proper regard for the eventual working out of mine and basis for advanced openings. No mine in Lake Superior district, regardless of size or development, turns out same total of mass and barrel work that Mass shows. Two shafts in operations, B and C. First down to 18th level. At this depth attack on Butler lode commercially successful. Considerable tonnage now secured from raise on lode from 17th level. Butler lode steeper than shaft and crosscut from 18th level or from next horizontal point of attack below 17th will be comparatively short. In fact lode undoubtedly crosses line of shaft at about the point where 19th level will be. At crosscut from 17th, raise in lode now within 40 ft. of crosscut from 15th and this will be holed through within a few months. Lode at this point showing average productivity. Other shaft, C, now has attained depth of 250 ft. below 9th. It is substantial producer of average-grade milling rock and some mass material.

Iron

INDIANA (Iron Mountain)—Operations to be resumed at early date.

TULLY (Iron River)—Seventy miners given places during past week. Mine operated by Corrigan-McKinney.

BRISTOL (Crystal Falls)—Mine resumed operations Feb. 1, with 250 hands. Property closed last summer, when slump came. Now few idle men in city.

DUNN (Crystal Falls)—Corrigan, McKinney & Co. added 100 men to working force Feb. 1. Crew now up to normal. Territory adjacent to old property, secured short time ago, known to contain considerable ore and management has already started after it.

AMERICAN (Diorite)—Attempt made on Sunday morning, Jan. 31, to dynamite home of Capt. S. J. Perkins. Two sticks of dynamite set off on front porch, blowing off porch and small part of house. None of occupants injured. Person responsible not known. Mine recently resumed after being closed since Aug. 1, 1914. Many men applied for work during January but there were places for only about 100, in addition to 150 employed in development and repair work while shaft was being fixed. Believed some one sought revenge for not being given place. One day last month 264 men journeyed to Diorite from Ishpeming, 10 miles, seeking work. Captain Perkins went to Diorite last fall from Gwinn, where he was employed as mining captain by Cleveland-Cliffs; was for number of years in charge of Ashland mine on Gogebic range.

MINNESOTA

Cuyuna Range

E. J. LONGYEAR CO. (Brainerd)—After drilling nine holes on Crow Wing County poor farm, company has surrendered option of lease. Excessive depth of surface, 200 to 250 ft., overlying iron formation, is cause of move.

CUYUNA-SULTANA (Ironton)—Bids being received for removal of 1,000,000 yards of overburden, which will uncover about eight acres, surface averaging about 60 ft. Drag-line method of stripping decided upon as most economical.

Mesabi Range

LA RUE (Nashwauk)—Excavation for washing plant now completed. Much repair work being done in anticipation of busy season.

IROQUOIS (Mountain Iron)—This mine, last operated by Rogers-Brown Ore Co., now being dismantled of machinery for shipment to Grand River, Mich. Stated orebody is not entirely exhausted.

HAWKINS (Nashwauk)—Company has completed erection of $3000 clubhouse for employees, with all modern conveniences. Machinery now being installed in recently constructed steel and concrete machine shops.

SCARCITY of underground miners reported in Virginia district; probably will increase as season opens. At Alpena mine 700 men employed underground at present, while Lincoln has 200 and Minorca works three full shifts. Common labor still remains plentiful.

QUINN-HARRISON (Nashwauk)—Location consisting of 30 residences will be built on company's property as soon as weather permits. Butler Bros. will begin construction of shops at early date. Work on superstructure of washing plant will begin within a few days.

MISSOURI-KANSAS-OKLAHOMA

CHILDRESS & CO. (Galena, Kan.)—Now cribbing shaft lost when mines caved a few weeks ago, carrying down hoist and other machinery; expected to get shaft cleaned out, as it was damaged but little by cave; machinery is lost, being completely buried several feet under waste rock and débris. Company expects to go under caved ground and timber it up, working lower level at 125 ft. where good run of zinc ore is known to exist.

BATTLEFIELD MINING CO. (Galena, Kan.)—New shaft started on north side of forty-acre tract south of Galena to catch ore run that Diplomat Mining Co. mined up to Battlefield north line. Diplomat working at 100-ft. level has been making good turn-ins for some time. Mr. Sapp, owner of Battlefield, expects to strike same run at 100-ft. level and says he will be hoisting pay dirt within 60 days. Battlefield shut down mill and other mines on land on account of low price of spelter, but will now unwater ground and start mill shaft in a short time, or as soon as the water is out of ground and needed repairs made on mill. Battlefield has been great producer in past and with new development in new shaft and water out of the old workings, tract will soon be paying good dividends again.

MONTANA

Fergus County

BARNES KING (Kendall)—December report brings to close unusually prosperous year. Amount realized from North Moccasin in gold bullion was $424,411; tons mined and milled 51,471, making average return nearly $8.25. Average cost of mining and milling will probably run between $4.25 and $4.75 leaving net profit of between $3.50 and $4.00, about $200,000 for 1914. During year final payment made for North Moccasin mine, and Piegan Gloster mill at Marysville rebuilt, all out of earnings of North Moccasin.

Silver Bow County

ANACONDA (Butte)—Production apparently back to 60% or 65% of normal, as against 50% in last part of 1914. January yield, 13,700,000 lb., largest since August.

EAST BUTTE (Butte)—Rumors of resumption denied by management. Mine closed since Aug. 5, engaged in repair and development work and in making changes in smelting plant. Plant will have larger capacity and be more economical.

NEVADA

Esmeralda County

GOLDFIELD CONSOLIDATED (Goldfield)—Estimates for January: Tonnage, 30,563; gross extraction, $414,000; net realization, $232,000.

GOLDFIELD MERGER (Goldfield)—This company, together with Deep Mines Co. reported as thrown into receiver's hands on application of Lucy Ames, shareholder.

GOLDFIELD EMPIRE MINING CO. (Goldfield)—Property of four claims sold to Reno men. First payment made, machinery ordered and work to start soon on 150-ft. level of shaft.

JUMBO EXTENSION (Goldfield)—East and west drifts being driven from top of raise 503-D on 1017-ft. level; faces in ore assaying $25 and $17 respectively. West drift from raise 503-C opened 6-ft. oreshoot assaying $28 per ton. Oreshoot 4 ft. wide assaying $69 per ton being stoped in east drift on 921-ft. level. East drift on 865-ft. intermediate level in $9 ore. Exploratory work under way on intermediate, A, level below 921-ft. level. Main shaft being repaired between 800- and 1000-ft. points. Original Velvet shaft, 400 ft. deep,

will be enlarged from two compartments to three and sunk to 1017-ft. level to facilitate development work in northeast portion of Velvet claim. Eight-drill air compressor and 75-hp. electric hoist will be installed.

Humboldt County

AT ROCHESTER recent development work on Red Top lease, Rochester Snowstorm, Paymaster and Octopus progressing with satisfactory results. Sixty-room hotel in Lower Rochester being built by F. W. Kittle.

ROCHESTER MINES CO. (Rochester)—Power line from Lahontan to new mill finished, but due to delay of manufacture of transformers, power cannot be supplied before middle of February.

STOWELL MINING & LEASING CO. (Rochester)—A 400-ft. crosscut tunnel being driven to cut at depth oreshoot opened at surface. Some ore showing free gold opened and large tonnage milling-grade ore developed.

Lander County

GOLD-COPPER STRIKE AT HILLTOP made recently. Shoot opened on surface, stated to be 6 ft. wide, assaying well in both gold and copper.

Lincoln County

DAY-BRISTOL (Pioche)—Property sold by receiver on Jan. 19 for $99,200 to representative of A. W. Middleton, of New York. If property is worked, which will result in operation of Pioche-Pacific R.R., many properties in Jack Rabbit district will be worked.

Lyon County

SMITH VALLEY MINES CO. (Yerington)—Suit against receiver of this company instituted by Reading Mercantile & Transportation Co.

NEVADA DOUGLAS (Ludwig)—Reported reorganization in prospect. Special stockholders' meeting called for Mar. 4 in Salt Lake City to vote on consolidation with Moore Mining Co. New company to be called Nevada-Douglas Consolidated Copper Co., capitalized for 1,000,000 shares, par value $5 per share, will assume liabilities of present companies, $525,000 of Nevada-Douglas and $57,000 of Moore, and take over all assets of both; Nevada-Douglas stockholders will receive share for share in new stock for present holdings and 10,000 shares will be issued to Moore company for property. New stock will be assessable and assessment of 10c. per share evidently contemplated.

Mineral County

PITTSBURG-NEVADA (Rockland)—Severe weather has interfered with mill construction.

Nye County

TONOPAH EXTENSION (Tonopah)—New fire protection system being installed.

JIM BUTLER (Tonopah)—Improvements at Wandering Boy shaft completed and mining to begin at once.

TONOPAH VICTOR (Tonopah)—Water lowered to 1335-ft. level. New pumps will be put in operation at once.

DEXTER-WHITE CAPS (Manhattan)—Preliminary negotiations with Tonopah Mining Co. to take 60% interest concluded. Mine will be examined and ore tested; if results satisfactory, Tonopah Mining Co. will take short-time option for exploratory work.

BULL HEAD (Manhattan)—This property until recently known as Gold Crater, owned by Mushett and Wittenberg, has started operations and in drift north from working shaft on 150-ft. level cut zone of enriched schist, supposedly continuation of belt found in Big Pine and Reilly Fraction properties.

BIG PINE (Manhattan)—Gloryhole operations keep new mill grinding on from 100 to 125 tons of fines, which represents total of about 400 tons of rock broken and hoisted each day. Large proportion of oversize is due to fact that crusher is too small to crush enough tonnage to keep tube mill employed steadily. Grade of ore to mill steadily improving with depth gained in gloryhole work. Waste stacker and classifier in mill are latest improvements in equipment.

Storey County

C. & C. SHAFT (Virginia City)—Electric cable being installed to conduct power to pumps to be placed on 2700-ft. level.

NEW YORK-NEVADA MINING CO. (Virginia City)—Twelve-months lease granted Virginia City men by referee in bankruptcy.

White Pine County

NEVADA CONSOLIDATED (McGill)—Stated recovery of entire plant, with oil-flotation process installed in one unit, increased from 68% to 71%. Copper content of tailings from this unit exceedingly low; gold recovery greatly increased.

NEVADA STAR MINING CO., Ltd. (Cherry Creek)—Liquidation and reorganization to take place at once. Assets to be disposed of to new corporation. Liquidator, Alfred Cornelius Stonehouse, 25 Bond St., Leeds, England.

NEW MEXICO

Dona Ana County

ORGAN MINES LEASING CO. (Organ)—Company has filed articles of incorporation. Norval J. Welsh named as agent. Mines situated at Organ.

Grant County

CHINO COPPER CO. (Hurley)—Excessive burden of icicles on one of main flumes caused capsize. Large quantity of stored water lost before it could be turned off.

BURRO MOUNTAIN COPPER CO. (Tyrone)—Experimental mill operation ceased. Work being pushed on 1000-ton concentrator. Drilling for water throughout Phelps-Dodge ground continues.

Otero County

LA LUZ COPPER CO. (La Luz)—Articles of incorporation filed. Capitalization $250,000; $197,000 paid in. J. G. Barrett statutory agent.

Socorro County

TREASURER MINING CO. (Mogollon)—Order of foreclosure in case of Waters vs. company set aside by Judge Mechem at Santa Fe.

UTAH

Juab County

GRAND CENTRAL (Eureka)—New orebody opened on 900.

DRAGON (Silver City)—Recent gold strike on 600 has opened up to 12 ft. in width. Ore being shipped with copper ore from same part of property.

MAMMOTH (Mammoth)—Work on 600 level will be resumed as soon as company's water line from Cherry Creek is repaired. Good body of ore running well in copper and silver opened on this level.

IRON BLOSSOM (Silver City)—Work during past year increased available ore supply. Ore, some of which carries native silver, being mined from Van stope, on 500 level of No. 3 workings.

EAGLE & BLUE BELL (Eureka)—Orebody recently opened on 1700 developed for 270 ft. vertically, up to 26 ft. across, and 50 ft. on strike. Ore extends below 1700. Two raises being driven on ore, 50 ft. apart. Chief value in silver and lead.

Salt Lake

MONTANA-BINGHAM (Bingham)—Company's tunnel now in nearly 3500 ft., and good progress being made.

UTAH COPPER (Bingham)—During December ore mined averaged 1.6% copper, highest tenor in recent months; compares with 1.45% and 1.43% in second and third quarters respectively of 1914; 6,795,567 lb. copper produced. Starting of Arthur mill due in part to difficulty of handling frozen material in bins; also reported some changes and possible additions will be made to flotation plant at Magna mill.

OHIO COPPER (Bingham)—Reported attempts will be made to reorganize, but whether through foreclosure of mortgage not determined. Committee formed to try and put property upon its feet, Junius Beebe, of Boston, represents Boston interests on committee; chairman, G. M. P. Murphy, of New York; N. J. Catrow, of Salt Lake, third member. Several months ago bondholders' committee formed, which included W. O. Allison, president. This committee not active of late. New committee already represents $200,000 bonds but does not propose to antagonize original committee. With flotation process for treatment of Ohio ores, possible property may be made to operate at profit. In event of reorganization merger of Ohio and Bingham Central Ry. may be made.

Summit County

SILVER KING COALITION (Park City)—New strike made on 1450 thought to be continuation of Silver King Consolidated orebody. On 1300 drift is within 100 ft. of the 1700 level of Consolidated. Connections to be made here to provide better ventilation for both properties, and to add to safety.

SILVER KING CONSOLIDATED (Park City)—Development work on 1800 level being done on fissure responsible for large orebody between 1550- and 1700-ft. levels. Several stringers of ore cut. Forty-five tons daily being shipped from development.

Tooele County

GALENA KING (Stockton)—New lessees at this property have opened ore on main level, and resumed shipments. Ore runs well in galena, with fair amount of silver.

CANADA

Alberta

PLACER MINING certificates allowing holders to mine for gold by hand methods on North Saskatchewan River about Edmonton to be granted according to word received in Edmonton from department of mines at Ottawa. Rocker and grizzly methods to be allowed on strips of land 100 ft. wide over which the water extends at high water, but which are not covered at low water. Operations will be under direct supervision of mining recorder of district. As about 200 claims were worked until freezeup, it is likely mining will be active along river with going out of ice in spring.

Ontario

RIGHT OF WAY (Cobalt)—Owners considering reopening of property and prosecution of further development work.

DOME LAKE (South Porcupine)—Directors considering proposal to double capacity of mill.

SCHUMACHER (Schumacher)—Company buying machinery for mill. Dorr continuous decantation cyanide plant will be installed.

DOME (South Porcupine)—Mill tonnage for January expected to be 25,000 with gross value in excess of December production.

HOLLINGER (Timmins)—Four-weekly report for period ended Dec. 31 showed gross earnings of $156,059. Mill treated 20,775 tons averaging $12.28; total working costs $4.37 a ton.

MEXICO

Hidalgo

REAL DEL MONTE—Improvement in operations reported; production back to 60%, from 35% in last part of 1914. Cyanide fairly plentiful. Further increase in operations expected.

The Market Report

Metal Markets

NEW YORK—Feb. 10

Copper has been very dull and lower. Tin has been lower on small business. Spelter has been higher, although there has been less excitement, the facts of the peculiar situation having become well recognized. Lead has been dull, but a little firmer in tone.

Copper, Tin, Lead and Zinc

Copper—The lull in buying which was in evidence toward the close of our last report became pronounced. The large producers quietly maintained their previous asking price, or rather made no effort to solicit additional business, being well satisfied with the large sales effected during the previous three months. Dealers, however, who are anxious to do business all the time immediately began to quote the market down, hoping to find a level at which copper could be turned over. Raw material from foreign sources was available on the basis of 14c., New York, for electrolytic. The buyers were quite willing to turn over their purchases at ⅛c. profit. Toward the close electrolytic copper was offered at 14¼ @14½c., regular terms, with intimations that prices might be shaded and suspicions that some producers were offering sub rosa on that basis. However, the business transacted during the last week was inconsequential in volume, and in the absence of important transactions, quotations are but nominal.

Copper sheets base price is now 19¾c. per lb. for hot rolled and 20¾c. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire is quoted at 15@15¼c., carload lots at mill.

Copper exports from Atlantic ports for the week ended Jan. 30 are reported by the Bureau of Commerce at 15,389,322 lb. The larger shipments were 6,289,648 lb. to France, 4,832,978 lb. to Great Britain, 1,717,428 lb. to Italy and 1,456,536 lb. to Sweden. Imports reported are: Metal, 1,792,629 lb.; in ore and matte, 884,726 lb.; total, 2,677,355 lb. Imports were from Canada, Peru and Japan.

Visible stocks of copper in Europe Feb. 1 are reported as follows: Great Britain, 17,090; Rotterdam, 1150; afloat from Australia, 4400; afloat from Chile, 2975; total, 25,615 long tons, a decrease of 310 tons during January.

Tin—But very little business was done. The price was a little easier. Conditions generally remain about as reported last week.

Visible stocks of tin on Feb. 1 are reported as follows: London, 6970; United States, excluding Pacific ports, 6931; total, 13,901 long tons, an increase of 505 tons during January.

Shipments of tin from the Straits in January were 5105 long tons, a decrease of 185 tons from last year.

Lead—Business in this metal was light in volume. A little carload business was reported at about 3.85c., New York, but the A. S. & R. Co., and other large producers continued to be sellers at 3.80c. In the St. Louis market the tone was a little firmer. Certain producers were asking 3.70c., but this was not reported as realized.

According t the chairman of the Broken Hill Block 10 Co., about 40% of the lead concentrates of Broken Hill are now being treated by Australian smelters.

Spelter—A con iderable business was done, producers having found it easi to place April and later deliveries, sales of which aggregated some thousands of tons. A less volume of business for March delivery was done, and there was a little carload business for spot and prompt deliveries. The total volume of the last is insignificant and necessarily so, the supply having been practically exhausted. Here and there 100 tons or so are available, and when a consumer must have some he is obliged to pay high for it. Thus, 8⅛c., St. Louis, was realized last week on such business. April-May business was done in large tonnages at about 7⅝@7¾c. On some contracts running forward to July, considerably lower prices were accepted.

In general the smelters are not very well sold beyond March, although the position of the several concerns differs in that respect. On the other hand, some of the large consumers are supposed to have failed as yet to cover all of their March requirements. As to whether the rise in spelter has culminated or not much difference of opinion is expressed. The determinative conditions are greatly confused.

The prices realized for brass special ranged from 9½@11c., with evidences of recession in the latter part of the week when there appeared to be more sellers of this kind of metal than buyers. If the demand for brass special should exhibit a material relaxation, the tension in the market for Prime Western would naturally be eased also.

Zinc sheets were advanced during the week to 11c., then to 12c. per lb., and were quoted today at $12 per 100 lb., f.o.b. La Salle. Ill., less 8% discount. Usual extras charged.

Difficulties having arisen in the Zinkhüttenverband owing to the closure of some of the Belgian works and the general derangement of conditions, the union was dissolved at a meeting at Berlin, Jan. 7, 1915, and an incorporation known as the Zinkhüttenvereinigung, m. b. H. was substituted.

DAILY PRICES OF METALS IN NEW YORK

			Copper	Tin	Lead		Zinc	
Feb.	Sterling Exchange	Silver, Cts. per Oz.	Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
4	4.8363	48¼	*14.40 @14.50	37	3.80	3.65 @3.70	7.67½ @8.17½	7.50 @8.00
5	4.8363	48¼	*14.35 @14.45	37	3.80	3.65 @3.70	7.80 @8.30	7.62½ @8.12½
6	4.8350	48¼	*14.30 @14.40	37	3.80	3.65 @3.70	7.80 @8.30	7.22½ @8.12½
8	4.8350	48¼	*14.20 @14.30	37	3.80	3.65 @3.70	7.80 @8.30	7.22½ @8.12½
9	4.8300	48⅜	*14.10 @14.20	36	3.80	3.65 @3.70	7.80 @8.30	7.22½ @8.12½
10	4.8313	48¼	*14.10 @14.20	36	3.80	3.65 @3.70	7.80 @8.30	7.22½ @8.12½

*Nominal.

The quotations herein are our appraisal of the markets for copper, lead, speltes and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business and 0.25 to 0.37½c. on European. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

		Copper				Tin		Lead		Zinc	
		Spot									
Feb.	Silver	£ per Ton	Cts. per Lb.	3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
4	22⅜	62⅛	13.50	62⅜	....	171	152	18 11/16	4.06	38	8.26
5	22⅜	62⅛	13.53	62⅞	68¼	176	152½	18 11/16	4.06	38⅛	8.36
6	22⅜	....	....	....	....	....	....	....	....	....	....
8	22 9/16	62⅜	13.63	63	....	176	155	18 11/16	4.06	38⅛	8.36
9	22 9/16	62⅛	13.58	63	69¾	173½	153	18⅛	4.05	39¼	8.58
10	22⅝	62⅞	13.66	63⅜	....	174	154	18 11/16	4.06	39½	8.63

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10=2.17½c.; £15=3.26¼c.; £20=4.35c.; £30=6.52c.; £60=13.05c. Variations, £1 = 0.21¾c.

Other Metals

Aluminum has been in rather better demand, with increased inquiry and some sales. Quotations are a shade firmer, at 19@19½c. per lb. for No. 1 ingots, New York—**Antimony** has been strong and active, with large sales, both domestic and for export. The close is rather excited, with prices uncertain. Ordinary brands are quoted at 17@18c. per lb., while 20@21c. is asked for Cookson's—**Nickel** is unchanged, ordinary forms being 40@45c. per lb., according to size and terms of order. Electrolytic, 3c. higher—**Quicksilver** has been strong with a decided upward tendency. In New York sales were made at $53, but at the close the leading interests quoted $54@57. San Francisco, $55 per flask for domestic orders. London price is £11 2s. 6d. per flask.

Gold, Silver and Platinum

Gold in the United States Feb. 1, as estimated by the Treasury Department: Held in Treasury against gold certificates outstanding, $988,590,269; in Treasury current balances, $212,106,479; in banks and circulation, $623,050,364; total, $1,823,747,112, an increase of $7,740,793 during January.

Sales of gold bars at the Assay Office in New York in January amounted to $3,795,795, an increase of $2,039,937 over December, 1914, but a decrease of $161,768 from January, 1914.

At New York, Feb. 8, a consignment of $1,000,000 in gold arrived from South America. It is understood that this was largely new gold from mines.

Platinum—The market continues quiet, with only moderate sales. Prices are still rather irregular, $38@42 per oz. being named for refined platinum; while $45@49 per oz. is quoted for hard metal, according to quality.

Silver—Latest advices indicate large shipments to India. This situation gives steadiness to the market; otherwise it is probable the price would have declined. Considerable silver has recently been shipped to France. Beyond this information there do not seem to be any new features.

Coined silver in the United States Feb. 1, as estimated by the Treasury Department: Standard dollars, $565,941,478, of which $476,018,000 are held in Treasury against silver certificates outstanding; subsidiary coins, $184,797,402; total, $750,738,880, an increase of $253,775 during January.

Exports of Metals and Minerals from Spain, 10 months ended Oct. 31, as reported by "Revista Minera," in metric tons:

	Metals		Ores, etc.	
	1913	1914	1913	1914
Iron	8,301	20,375	7,575,786	5,584,125
Copper	21,411	16,098	134,458	82,187
Copper precipitate	4,227	8,552	.....	.....
Lead	175,648	127,263	1,808	1,580
Zinc	1,025	2,791	94,598	65,468
Manganese	.....	.....	22,353	8,308
Quicksilver	1,477	1,273	.....	.....
Pyrites	.....	.....	2,468,511	2,452,064

Exports of salt for the 10 months were 471,870 tons in 1913, and 467,183 tons in 1914. Imports of coal in 1914 were 2,198,254 metric tons; of coke, 308,020 tons.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Feb. 6

The base price paid this week for 60% zinc ore was $65@66 per ton. No sales of lead ore were reported. Shipments were curtailed due to the heavy snow blockade.

SHIPMENTS, WEEK ENDED FEB. 6

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	1,698,210	.....	166,000
Year	19,381,020	226,000	1,870,700

Shipments this week to separating plants, 2,084,700 lb. zinc ore.

The report for Jan. 30, receipt delayed by storm, shows sales of zinc ore at $60@63 per ton of 60% zinc; no sales of lead ore. Shipments for the week 5,006,460 lb. zinc ore and 335,500 lb. sulphur ore. Shipped to separating plants, 3,428,050 lb. zinc ore.

JOPLIN, MO.—Feb. 6

Blende, high price, $71; assay base, 60% zinc, $62@69; metal base, 60% zinc, $65@66; calamine base, 40% zinc, $43@46; average, all grades of zinc, $61.75 per ton. Lead, high price, $49; base price, $47 per ton of 80% metal contents; average, all grades of lead, $48.08.

Fully one-fourth the shipment again this week is from reserve stocks, but the unusually large shipment indicates some improvement in the production. The base price of the week for best grades of zinc ore was fixed yesterday, but bidding on metal base continued until late tonight.

SHIPMENTS, WEEK ENDED FEB. 6

	Blende	Calamine	Lead	Values
Total this week....	12,253,580	1,134,580	1,714,900	$454,810
Total this year.....	61,345,590	4,969,740	8,831,640	1,924,670

Blende value, the week, $394,170; six weeks, $1,645,410.
Calamine value, the week, $19,190; six weeks, $72,830.
Lead value, the week, $41,460; six weeks, $206,430.

Iron Trade Review

NEW YORK—Feb. 10

The month of January showed an increase of 5.7% over December in the make of pig iron, while the capacity of the furnaces in blast, Feb. 1, was greater by 15.2% than on Jan. 1. The increase came more largely from the steel works stacks than from the merchant furnaces, indicating an increase in the demand for finished steel; and this is confirmed by reports from the mills.

New business in pig iron is rather slow, especially in basic iron; on the other hand, buyers are reported to be taking iron more freely on contracts.

Increasing business is fairly well distributed, the most backward department being in structural steel. Railroad buying is improving and orders for rails are more frequent, though inclined to be small.

Some good foreign orders for wire and for shrapnel steel are reported from abroad. High ocean freights are interfering to some extent with this foreign trade.

In addition to the billet order noted last week, the Tennessee Coal, Iron & R.R. Co. has orders to roll 10,000 tons of rails to go to Chile and 7500 tons to Russia. These will be rolled at Ensley.

Pig Iron Production in January showed an increase over December. The reports of the blast furnaces, as collected and published by the "Iron Age," show a total of 160 coke and anthracite stacks in blast on Feb. 1, having a total daily capacity of 56,300 tons; an increase of 7500 tons over Jan. 1. Allowing for the charcoal furnaces, the estimated make of pig iron in the United States in January was 1,629,400 long tons. Of this total 1,115,900 tons, or 68.5%, were made by the furnaces owned or operated by steel works.

PITTSBURGH—Feb. 9

Steel orders are increasing slowly in most lines, though plates and shapes are rather backward. Tubular goods and wire products are gaining steadily. Bookings as a whole are of considerably larger volume thus far this month than in the corresponding period of any previous month since the war began.

The steel industry of the country is now operating at more than 50% of capacity and production continues to increase. Indications are now distinct that the improvement is to continue steadily, even though gradually. There are no signs of a backset such as occurred a year ago at this time after a somewhat similar improving movement.

The steel trade in Pittsburgh has been decidedly encouraged by the address at the Engineers' Society banquet last night by President James A. Farrell of the Steel Corporation. Mr. Farrell predicted a continued improvement in the steel trade, based upon his own minute and accurate observation of the flow of business, and formally announced the management was arranging for a resumption of the new construction work which was suspended last year on account of hard times.

The Steel Corporation's export branch last week booked 56,000 tons of export iron and steel, representing more than double the average rate of booking in 1914, and predictions are made that there will be further increases.

The Amalgamated Association has accepted a reduction of 11.2% in the sheet scale and a reduction of 6% in the tin-plate scale, on account of reductions made by various non-union mills. The union controls about 22% of all the sheet mills and about 11% of the tin-plate mills, and includes tonnage labor only.

Pig Iron—On a single carload inquiry yesterday a prominent producer quoted $13.60, Valley, on bessemer iron, or 15c. below the market quoted for some time past, but it is claimed that on a large inquiry $13.60 would not be shaded. Basic is largely nominal at $12.50, the old quotation, but seems firm at that figure. Demand for foundry iron is rather light but it is between buying movements, consumers being fairly well covered for the quarter. The pig-iron market is very steady even though quiet and elements of strength are that little if any iron is accumulating while hardly any of the idle furnaces would blow in unless offered advances of say $1 a ton over present quotations. The market stands as follows: Bessemer, $13.60; basic, $12.50; No. 2 foundry, $12.75@13.25;

forge, $12.50@12.75; malleable, $12.75, at Valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—Apprehensions as to the future supply of ferromanganese are approaching an acute stage. There have been no imports for some time, and while a number of consumers have signed the agreement prohibiting export of steel to certain countries they still do not receive shipments on their old contracts. An eastern steel interest has been trying to buy from Carneegie and Jones & Laughlin the past week without success, and is said to have a supply for only another fortnight. On an average the steel mills have alloy enough for about three months of operation at the present rate . While Carnegie and Jones & Laughlin are making ferromanganese they do not know whether they can secure much more manganese ore. The contract market remains $68, Baltimore, subject to the embargo. Small lots of spot can sometimes be picked up at $85 or thereabouts, and there is more offered at $100, though no important tonnage at any figure.

Steel—The widely reported withdrawal of the Carnegie Steel Co. from the billet and sheet-bar market is of no particular consequence, seeing that it had already covered its regular customers at attractive prices, and as noted last week its advanced asking prices were higher than delivered prices, Pittsburgh, based on quotations freely made by Youngstown mills, at $18.25 for billets and $18.50 for sheet bars. Rods are quite firm at $25, Pittsburgh.

Foreign Iron and Steel Trade of the United States, 11 months ended Nov. 30, is valued as below, by the Department of Commerce:

	1912	1913	1914
Exports	$265,377,556	$271,818,459	$184,922,071
Imports	26,679,274	30,787,211	27,104,665
Excess, exports	$238,698,282	$241,031,248	$157,817,406

In 1914, as compared with 1913, there was a decrease of $86,896,388, or 31.9%, in exports; and a decrease of $3,682,546, or 12%, in imports.

IRON ORE

A few cargoes of Swedish ore have arrived at Philadelphia, the ore being on old contracts. The vessels have loaded with coal for the return trip.

Several cargoes of Indian manganese ore have arrived at Philadelphia, consigned to the Carnegie Steel Co. This ore was shipped from India before the embargo was put on.

The division by ranges of water shipments of Lake iron ore for the year is given by the "Iron Trade Review" as follows, in long tons:

	1913	1914	Changes
Marquette	3,966,680	1,363,419	D. 2,603,261
Menominee	4,965,604	3,755,726	D. 1,209,878
Gogebic	4,531,558	3,664,451	D. 867,107
Baraboo	145,010	100,000	D. 45,010
Vermillion	1,566,600	931,077	D. 635,523
Mesabi	34,038,643	21,447,998	D. 12,590,645
Cuyuna	733,021	859,226	I. 126,205
Total	49,947,116	32,121,897	D. 17,825,192

The Cuyuna range alone showed an increase in 1914. In that year 72.3% of the total came from the Minnesota ranges and 27.7% from Michigan and Wisconsin.

Imports and Exports of Iron Ore in the United States, 11 months ended Nov. 30 were, in long tons:

	1913	1914	Changes
Imports	2,370,878	1,300,315	D. 1,070,563
Exports	1,027,572	549,392	D. 478,180

The larger imports in 1914 were 763,964 tons from Cuba; 280,887 tons from Sweden; 66,982 tons from Spain; 52,514 tons from Canada; 38,575 tons from Newfoundland and Labrador. Exports were chiefly to Canada.

COKE

Connellsville—The coke market continues stagnant. The steel interests have blown in quite a number of blast furnaces, and have increased their coke production accordingly, shipments in the week ended Jan. 30 being 28,000 tons in excess of those the previous week, but there are no merchant furnaces blowing in such as would throw additional business to the merchant coke operators. There has been scarcely any demand for prompt furnace coke and with continued offerings the market has sagged another 5c. to $1.50. There are no negotiations to give a line on contract prices. Foundry coke is $2@2.35 for prompt, while contracts for good brands could be made at $2.15@2.35 at ovens.

Anthracite Shipments in January were 4,831,329 long tons, a decrease of 449,315 tons as compared with January, 1914. These shipments this year were the lightest reported since 1905, in January.

Coal and Coke Tonnage of Pennsylvania R.R. lines east of Pittsburgh and Erie year ended Dec. 31, in short tons:

	1913	1914	Changes
Anthracite	10,711,335	11.201,150	I. 489,815
Bituminous	51,526,267	47,769,227	D. 3,757,040
Coke	13,892,825	9,548,354	D. 4,344,471
Total	76,130,427	68,518,731	D. 7,611,696

The total decrease in 1914 was 10%. The largest proportional loss was in coke.

Fuel Exports and Imports in the United States, 11 months ended Nov. 30, in long tons:

	Exports		Imports	
	1913	1914	1913	1914
Anthracite	3,927,995	3,645,777	913	19,335
Bituminous	16,856,781	13,105,304	1,248,796	1,207,281
Coke	805,320	544,098	78,913	114,862
Bunker coal	7,093,271	6,775,071	.....	.....
Total	28,683,367	24,070,250	1,328,622	1,341,478

The bunker coal, or coal furnished to steamers in foreign trade is practically all bituminous. The greater part of the trade, both imports and exports, is with Canada. There was a loss of 4,613,117 tons, or 16.1%, in exports; and a gain of 12,856 tons, or 0.9%, in imports.

SAULT CANAL TRAFFIC

The total movement of freight through the Sault Ste. Marie canals in 1914 is reported officially at 55,369,934 short tons, a decrease of 24,348,410 tons, or 30.5%, from 1913. The number of vessel passages in 1914 was 18,717, showing an average cargo of 2243 tons. The mineral freights included in these totals were, in short tons, except salt, which is in barrels:

	1913	1914	Changes
Coal	18,622,938	14,487,221	D. 4,135,717
Iron ore	48,109,353	31,413,765	D. 16,695,588
Pig and m'f'd iron	402,912	239,683	D. 163,229
Copper	85,378	91,764	I. 6,386
Building stone	6,181	.....	D. 6,181
Salt, bbl.	730,431	777,208	I. 46,777

The United States canal was open from April 20 to Dec. 17, or 242 days; the Canadian canal from April 20 to Dec. 14, or 239 days. In 1914 iron ore was 56.7%, and coal 26% of the total freight.

Chemicals

NEW YORK—Feb. 10

The general market is not especially active and is in rather an unsettled condition still.

Arsenic—The market is quiet, with supplies equal to the demand. Prices are steady at $3.75@4 per 100 lb. for both spot and futures.

Copper Sulphate—Business is steady and fairly good. Prices are again firmer, the current quotations being $4.75 per 100 lb. for carload lots and $5 per 100 lb. for smaller orders.

Nitrate of Soda—The market is active with much inquiry and fair sales. Prices have advanced rather sharply and the present quotations are 2.12½c. per lb. for spot and all deliveries up to July; while 2.10c. per lb. is named for later positions.

Pyrites—Arrivals at Baltimore for the past week included two cargoes, 10,411 tons, of pyrites from Huelva, Spain.

Potash Salts—A despatch from the U. S. Consul-General at Berlin says: "The Potash Syndicate, Berlin, on Feb. 1, decided to form a commission to consider means for denaturizing potash salts so as to preclude the possibility of using them for ammunition and military purposes and making them valuable only as fertilizers. Upon receipt of the report of the commission the syndicate will confer with the Government relative to moderating the embargo on potash. The syndicate would be seriously embarrassed by the continued absolute embargo—from Jan. 29, 1915—and large quantities of salts now under way would be detained."

PETROLEUM

The monthly statement of the "Oil City Derrick" shows new wells completed in January as follows: Pennsylvania grade, 291; Lima-Indiana, 24; Central Ohio, 114; Kentucky, 4; Illinois, 47; Kansas-Oklahoma, 379; Texas-Louisiana, 72. A total of 931 completed wells in the oil fields of the Mid-Continent and those east of the Mississippi in January gives a decrease of 121 from the December figures. New production of the same divisions amounted to 148,535 bbl., a decrease of 5773 bbl. There were 195 dry holes and 193 gas wells. At the close of January there were 221 rigs up and 1453 wells drilling.

Assessments

Company	Delinq.	Sale	Amt.
Belcher Silver, Nev.	Feb. 8	Mar. 1	$0.10
Blue Bull, Nev.	Jan. 4	Feb. 8	0.01
Booth, Nev.	Jan. 25	Mar. 1	0.02
Brunswick Con., Nev.	Feb. 16	Mar. 9	0.01
Caledonia, Nev.	Mar. 8	Mar. 31	0.05
Carbonate, Ida.	Jan. 28	Feb. 28	0.001
Cash Boy, Nev.	Jan. 15	Feb. 15	0.005
Cedar-Talisman, Utah	Feb. 8	Mar. 1	0.005
Clear Grit, Ida. (post.)	Feb. 9	Mar. 3	0.0015
Clearwater Con., Ida.	.....	Feb. 15	0.001
Darby, Ida. (post)	Dec. 14	Feb. 15	0.001
Emerald, Utah (three instal.)	.....	June 9	0.01
Gethin Le Roy, Utah (post.)	Feb. 16	Mar. 7	0.02
Gypsy Qn., Nev.	Jan. 12	Feb. 16	0.01
Idaho-Nev., Ida.	Jan. 7	Feb. 1	0.001
Indiana, Mich.	Feb. 4	.....	1.00
Iron King, Ida.	Feb. 18	Mar. 19	0.001
Keystone, Utah. (post)	Feb. 23	Mar. 23	0.02
King Pine Crk., Ida.	Feb. 12	Mar. 13	0.002
Lucky Friday, Ida.	Dec. 14	Feb. 11	0.003
Majestic-Idol, Nev.	Dec. 15	Jul. 20	0.005
Manhattan Con., Nev.	Feb. 30	Mar. 1	0.01
Nor. Bnkr. Hill, Ida.	Jan. 30	Mar. 6	0.002
Ophir, Nev.	Feb. 11	Mar. 5	0.10
Overman, Nev.	Mar. 8	Mar. 26	0.05
Pioche Coalition, Nev.	Feb. 10	Mar. 1	0.025
Reindeer-Queen, Ida.	Feb. 15	Mar. 8	0.003
Rescue-Eula, Nev.	Feb. 11	Mar. 22	0.01
Sheba, Utah.	Jan. 12	Feb. 24	0.05
Sierra Nevada, Nev.	Feb. 8	Mar. 2	0.05
Sunset Dev., Ida.	Jan. 18	Feb. 18	0.0025
Tarbox, Ida.	Jan. 28	Feb. 28	0.0025
Tar Baby, Utah.	Mar. 5	Apr. 5	0.005
Ton. Gip. Qn., Nev.	Jan. 12	Feb. 16	0.01
Tonopah Midway, Nev.	Mar. 12	Apr. 12	0.01
Umatilla, Nev.	Jan. 4	Feb. 8	0.01
Utah-United, Utah	Feb. 20	Mar. 15	0.01
Verde May, Ida.	Feb. 1	Mar. 1	0 001
Wolf Mountain, Utah.	Mar. 15	Apr. 14	0.0015

Stock Quotations

In general the steel stocks have been strong, accompanying renewed activity in the steel market. Bethlehem Steel common was very active, closing the week at 56¼, on renewed dividend rumors. This is despite the interview given out by Schwab that dividends were still some time off.

COLO. SPRINGS	Feb. 8	SALT LAKE	Feb. 8
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.05	Beck Tunnel	.07
Cripple Cr'k Con.	.01	Black Jack	.08
C. K. & N.	.06½	Colorado Mining	.11
Doctor Jack Pot.	.10	Crown Point	.01½
Elkton Con.	.49	Daly-Judge	5.25
El Paso	1.65	Gold Chain	.10
Findlay	.02½	Grand Central	.64
Gold Dollar	.04½	Iron Blossom	.96
Gold Sovereign	.03½	Little Bell	.10
Isabella	.17	Lower Mammoth	.06½
Jack Pot	.07½	Mason Valley	1.00
Jennie Sample	.03	May Day	.15
Jerry Johnson	.03	Opohongo	.01¼
Lexington	‡.009	Prince Con	.27½
Old Gold	‡.01	Seven Troughs	.03
Mary McKinney	.30	Silver King Coal'n.	2.85
Pharmacist	.01½	Silver King Con.	1.75
Portland	1.17	Sioux Con.	.02½
Raven B. H.	.03½	Uncle Sam	.06
Vindicator	1.28	Yankee	.05½

TORONTO	Feb. 8		
Bailey	.01½	Dome Exten.	.07
Coniagas	4.75	Foley O'Brien	.15
Peterson Lake	.24	Hollinger	22.25
Right of Way	.01	Imperial	.01½
Seneca Superior	1.00	Jupiter	.10
Silver Queen	.02½	McIntyre	.24
T. & Hudson Bay	30.00	Pearl Lake	.02
Timiskaming	.17	Porcu. Gold	‡.25
Wettlaufer-Lor.	.04½	Preston E. D.	.01
Big Dome	5.75	Rea	.15

SAN FRANCISCO	Feb. 8		
Comstock Stocks		Misc. Nev. & Cal.	
Aita	.13	Belmont	3.50
Belcher	.30	Jim Butler	.66
Best & Belcher	.06	Lone Star	.08
Caledonia	.24	MacNamara	.03
Challenge Con.	.05	Midway	.07
Confidence	‡.10	Mont.-Tonopah	.35
Con. Virginia	.05	North Star	.13
Crown Point (Nev.)	‡.01	Rescue Eula	.06
Gould & Curry	.03	West End Con.	.50
Hale & Norcross	.04	Atlanta	.29
Julia	.02	Booth	.30
Mexican	.40	C.O.D. Con.	.05
Occidental	.84	Comb. Frac.	.07
Ophir	.13	Jumbo Extension	.81
Overman	.07	Pitts.-Silver Peak	.14
Potosi	.02	Round Mountain	.34
Savage	.03	Sandstorm Kendall	.08
Sierra Nevada	.11	Silver Pick	.06
Union Con.	.20	Central Eureka	.25
Yellow Jacket	.21	So. Eureka	2.25

N. Y. EXCH.	Feb. 8	BOSTON EXCH	Feb. 8
Name of Comp.	Clg.	Name of Comp.	Clg.
Amalgamated	53¼	Adventure	1
Am.Sm.&Ref.,com	64¼	Ahmeek	245
Am. Sm. & Ref., pf.	103	Alaska Gold M.	30
Am. Sm. Sec., pf. B.	‡80	Algomah	.50
Anaconda	26¾	Allouez	42
Batopilas Min.	.75	Am. Zinc	20¾
Bethlehem Steel, pf.	104	Ariz. Com., ctfs.	4½
Chino	36	Bonanza	.32
Colo. Fuel & Iron	24	Butte-Ballaklava	2½
Federal M. & S., pf.	28	Butte & Superior	47
Great Nor., ore., ctf.	31½	Calumet & Ariz.	53½
Guggen. Exp.	51½	Calumet & Hecla	393
Homestake	113	Centennial	17
Inspiration Con.	18¾	Cliff	‡1
Mex. Petroleum	76½	Copper Range	33½
Miami Copper	18¾	Daly West	1½
Nat'l Lead, com.	49	East Butte	8¾
National Lead, pf.	108	Franklin	4½
Nev. Consol.	11¾	Granby	66½
Ontario Min.	2	Hancock	11¾
Phelps Dodge	‡175	Helvetia	.30
Quicksilver, pf.	1½	Indiana	4
Ray Con.	17¾	Island Cr'k, com.	45
Republic I&S, com.	20¾	Island Cr'k, pfd.	86
Republic I&S, pf.	74½	Isle Royale	21½
SlossSheff'd, com.	25	Keweenaw	2¾
Sloss Sheffield, pf.	‡82	Lake	6½
Tennessee Copper	29¾	La Salle	4
Utah Copper	52¾	Mass	3½
U. S. Steel, com.	40¾	Mayflower	5
U. S. Steel, pf.	104	Michigan	.50
		Mohawk	59¼
N. Y. CURB	Feb. 8	New Arcadian	5½
Name of Comp.	Clg.	New Idria Quick	‡3¾
Beaver Con.	.26	North Butte	23
Big Four	.07	North Lake	1
Blue Bell	.03½	Ojibway	.70
Braden Copper	7½	Old Colony	4
B. C. Copper	‡.50	Old Dominion	43½
Buffalo Mines	1/32	Osceola	69
Can. Cop. Corpn.	1¾	Quincy	56¾
Can. G. & S.	.03	Santa Fe	1
Caribou	.50	Shannon	5½
Chambers Ferland	.12	Shattuck-Ariz.	23¼
Con. Ariz. Sm.	.25	Superior	27½
Coppermines Cons.	1½	Superior & Bost.	1¾
Davis-Daly	1 1/16	Tamarack	32
Diam'field-Daisy	.07	Trinity	2½
Dia. Black B.	.03	Tuolumne	.26
Ely Con.	‡.01	U. S. Smelting	20¾
Florence	.62	U. S. Smelt'g, pf.	40
Goldfield Con.	1½	Utah Apex	2
Goldfield Merger	.21	Utah Con.	9½
Greene Cananea	23½	Victoria	1¾
Kerr Lake	4½	Winona	1½
La Rose	⅛	Wolverine	43
McKinley-Dar-Sa.	.42	Wyandot	.50
Mines of Am.	2¼		
Mutual Min., pf.	‡2½	BOSTON CURB	Feb. 8
Nevada Hills	.30	Name of Comp.	Bid.
New Utah Bingham	‡1/16	Alvarado	.60
Nipissing Mines	5½	Bingham Mines	‡3¾
Ohio Copper	.01½	Boston Ely	.13
Oro	.10	Butte & Lon'n Dev.	.23
Pacific Smelt	1/32	Calaveras	.98
Stand'd Oil of N.J.	400	Calumet-Corbin	.14
Standard S. L.	1¾	Chief Con.	.65
Stewart	1 11/16	Corbin	‡1
Tonopah	6¾	Cortez	.15
Tonopah Ex.	2 7/16	Crown Reserve	.73
Tonopah Merger	36½	Eagle & Blue Bell	.85
Tularosa	1/16	First Nat. Cop.	1 1/16
West End Ex.	.03¾	Houghton Copper	1½
Yukon Gold	3¾	Iron Cap Cop., pf.	‡5
		Majestic	.14
LONDON	Jan. 27	Mexican Metals	.15
Alaska Tre'dwell	£7 12s 6d	Nevada-Douglas	.37
Camp Bird	0 8 0	New Baltic	1¾
El Oro	0 9 6	Oneco	‡.60
Esperanza	0 8 9	Raven Copper	.07
Mexico Mines	4 2 6	Smokey Dev.	.10
Oroville	0 12 9	So. Lake	4¾
Philippine Dr.	1 0 0	Tonopah Victor	‡.17
Santa Gert'dis.	0 11 3	Trethewey	.12
Tomboy	1 3 9	United Verde Ext.	1 1/16
Tough Oakes	0 13 9		

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	.....	28.357	26.573	.....
March	57.870	58.067	.....	26.669	26.788	.....
April	59.490	58.519	.....	27.416	26.958	.....
May	60.361	58.175	.....	27.825	26.704	.....
June	58.990	56.471	.....	27.199	25.948	.....
July	58.721	54.678	.....	27.074	25.219	.....
August	59.293	54.344	.....	27.335	25.979	.....
September	60.640	53.290	.....	27.986	24.260	.....
October	60.793	50.654	.....	28.083	23.199	.....
November	58.995	49.082	.....	27.263	22.703	.....
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	.....	65.259	.....	70.188	.....
March	14.131	.....	64.776	.....	69.170	.....
April	14.211	.....	64.747	.....	69.313	.....
May	13.996	.....	63.182	.....	67.786	.....
June	13.603	.....	61.336	.....	66.274	.....
July	13.223	.....	60.540	.....	64.955	.....
August	*	.....	‡	.....	‡	.....
September	*	.....	‡	.....	‡	.....
October	*	.....	‡	.....	‡	.....
November	11.739	.....	53.227	.....	*	.....
December	12.801	.....	56.841	.....	*	.....
Year	13.602	.....	61.524	.....	68.168	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	.....	181.556	.....
March	38.038	.....	173.619	.....
April	36.154	.....	163.963	.....
May	33.360	.....	150.702	.....
June	30.577	.....	138.321	.....
July	31.707	.....	142.517	.....
August	*	.....	‡	.....
September	32.675	.....	‡	.....
October	30.284	.....	‡	.....
November	33.304	.....	139.391	.....
December	33.601	.....	147.102	.....
Av. year	34.301	.....	156.564	.....

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	.....	3.937	.....	19.606	.....
March	3.970	.....	3.850	.....	19.651	.....
April	3.810	.....	3.688	.....	18.225	.....
May	3.900	.....	3.808	.....	18.503	.....
June	3.900	.....	3.810	.....	19.411	.....
July	3.891	.....	3.738	.....	19.051	.....
August	3.875	.....	3.715	.....	‡	.....
September	3.828	.....	3.658	.....	‡	.....
October	3.528	.....	3.384	.....	‡	.....
November	3.683	.....	3.585	.....	18.500	.....
December	3.800	.....	3.662	.....	19.097	.....
Year	3.862	.....	3.737	.....	19.079	.....

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	.....	5.228	.....	21.413	.....
March	5.250	.....	5.100	.....	21.460	.....
April	5.113	.....	4.963	.....	21.569	.....
May	5.074	.....	4.924	.....	21.393	.....
June	5.000	.....	4.850	.....	21.345	.....
July	4.920	.....	4.770	.....	21.568	.....
August	5.568	.....	5.418	.....	‡	.....
September	5.380	.....	5.230	.....	‡	.....
October	4.909	.....	4.750	.....	‡	.....
November	5.112	.....	4.962	.....	25.016	.....
December	5.592	.....	5.430	.....	27.369	.....
Year	5.213	.....	5.061	.....	22.544	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	.....	14.12	.....	14.08	.....
March	15.07	.....	13.94	.....	14.10	.....
April	14.90	.....	13.90	.....	14.13	.....
May	14.90	.....	13.90	.....	14.27	.....
June	14.90	.....	13.90	.....	13.96	.....
July	14.90	.....	13.90	.....	13.90	.....
August	14.90	.....	13.90	.....	14.08	.....
September	14.90	.....	13.90	.....	14.03	.....
October	14.84	.....	13.75	.....	13.97	.....
November	14.59	.....	13.43	.....	13.83	.....
December	14.70	.....	13.45	.....	13.83	.....
Year	$14.88	.....	$13.78	.....	$14.01	.....